Ontario

# Sprouted Seeds
# Good Manufacturing Practices Guidebook

Ministry of Agriculture, Food and Rural Affairs

**The primary objective of every food safety program is to prevent, minimize and control microbial, chemical and physical contamination.**

For information or to obtain copies of this publication, contact the Ontario Ministry of Agriculture, Food and Rural Affairs at (519) 8260-4395 or 1-888-466-2372 ext. 64395 or fpo.omafra@ontario.ca

**This *Sprouted Seeds Good Manufacturing Practices Guidebook* provides guidelines for a number of food safety practices. While the information provided herein is believed to be accurate, it is not intended to be an all-inclusive description of food safety practices for the production of sprouted seeds. The Ontario Ministry of Agriculture, Food and Rural Affairs does not make any warranty or guarantee, nor does it assume any liability for any production loss, health, safety or environmental hazard caused by use of information contained herein. This guidebook is neither an endorsement of specific food safety practices, companies or products nor a suggestion that other practices, companies or products are unacceptable.**

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# PREFACE

## What Are Good Manufacturing Practices (GMPs)?

Good Manufacturing Practices (GMPs) (or Prerequisite Programs) are common-sense practices for creating the conditions required to prevent, minimize or control microbial, chemical and physical contamination in a food production environment.

GMPs are the foundation of every food safety program. There are four basic elements in a GMP Advantage program. Each is based on the principle of risk reduction through prevention. They are:

- Control Programs - written operational and training policies and descriptions of the resulting operational and training procedure that are applied during Training and through Operational Controls
- Training - the training procedures
- Operational Controls - the operational procedures in the food production facility
- Environmental Controls - creation of a physical environment favourable for the production of safe food.

## GMP versus Prerequisite Program

The terms “Good Manufacturing Practices” and “Prerequisite Programs” are interchangeable. The term “Good Manufacturing Practices” is used throughout this guidebook.

## Why Apply Good Manufacturing Practices

Food safety is not an option; it’s an obligation. The market demands it. Those who fail to provide safe food risk loss of market share, loss of reputation and potential liability costs. Proof of compliance with food safety programs is increasingly becoming a condition of purchase by retailers.

Facing societal costs such as additional health care costs and lost productivity resulting from foodborne illnesses, governments are becoming less tolerant of anyone who sells contaminated food. In some jurisdictions (e.g., in some states of the United States), GMPs are a regulatory requirement.

Since their creation for NASA in the early 1960s, GMPs have proven to be an effective method of reducing food safety risks in processing facilities all over the world.

## Steps to Implement Good Manufacturing Practices

### 1. Get management commitment

Food safety experts tell us that lack of management commitment/leadership is the most frequent cause of food safety program failure. Successful implementation of a food safety program (e.g., Good Manufacturing Practices) requires high-level decisions, tough choices, and unwavering commitment to the program when things are not going well.

While senior management need not be directly involved in the day-to-day operation of the food safety program, they should continually demonstrate support and provide the necessary resources.

The following are examples of how management commitment and leadership is demonstrated:

- State, to employees, openly and often that food safety is important (and believe it).
- Initiate and attend food safety meetings and/or training.
- Personally adhere to all food safety safety-related procedures.
- Implement disciplinary consequences for plant employees not fulfilling their food safety responsibilities.
- Clearly define the responsibility and authority of those responsible for the food safety program.
- Emphasize importance of the food safety program by requiring that the food safety lead person report to management/ownership.

No food safety program can survive without adequate financial, time and labour resources. Management should provide the following:

- Provide and maintain the infrastructure required for a successful food safety program.
- Ensure staff, at all levels, are adequately trained to develop/implement/maintain food safety programs.
- Allocate sufficient time for staff to do their food safety–related jobs fully and correctly.
- Be available to the food safety team when difficult decisions need to be made.

**2. Form a food safety team**

The food safety team will be primarily responsible for designing, writing, implementing and maintaining the food safety program. For best results, the food safety team should draw on expertise in all areas of the facility.

Expertise areas may include:

- Quality assurance
- Production
- Maintenance
- Sanitation
- Shipping and receiving
- Management.

One person should oversee the team. That person should have:

- A strong understanding of the principles of food safety
- In-depth knowledge of the facility and its operations
- Technical knowledge of the hazards associated with the food product and the production and packaging process.

Whenever possible, one-person food safety teams should be avoided. However, in very small plants where there are only few employees, a food safety team of one may be unavoidable. In instances like this, the company should consider engaging the services of a consultant to provide any additional technical expertise that is required.

However, be careful when hiring a consultant. The food safety consulting business is unregulated, so do your homework. Check references, ask to see examples of work done for other companies and get a written contract.

Selecting a HACCP Consultant Factsheet and a Food Safety Consultant Directory is available on the OMAFRA Web site at:
http://www.omafra.gov.on.ca/english/food/inspection/haccp/consultdirect.htm

**3. Acquire training**

To enhance the chance of success, food safety team members need to have a clear understanding of food safety programs and their role in ensuring food safety. This is the time to identify and address knowledge deficiencies. Depending upon their role and level of involvement, team members may require different levels of knowledge and, therefore, differing amounts and types of training.

There are many training providers including organizations such as the Guelph Food Technology Centre, industry associations or consultants.

Knowledge may also be acquired by taking food safety courses, reading material prepared by OMAFRA (e.g., the *HACCP Advantage Program Manual,* and *HACCP Advantage Guidebook*), researching topics specific to your needs and talking with specialists (e.g., sanitation product suppliers or OMAFRA food safety advisers). Because different areas and levels of training may be necessary, a number of different training methods and sources may be required.

The same advice that applies to selecting a consultant also applies to selection of training providers: Be careful!

**4. Develop an implementation schedule**

An implementation schedule is your road map to completion of your food safety program.

Identify the major tasks, put them in chronological order and set some rough timelines around them. It's not necessary to get too specific at this point; estimate start and finish dates, keeping in mind that some tasks will be completed more quickly than anticipated and others more slowly. Review your progress regularly and be flexible, but try to keep on schedule.

Assign tasks to the person (or persons) on the food safety program team who is most qualified to handle them. For example, the head of the sanitation department should be the lead for preparation of sanitation procedures. Encourage the person in charge of each project to involve those in his or her department. By doing so, when it comes time to implement the program, everyone in the plant has a degree of ownership and an interest in seeing the program succeed.

**5. Obtain resources**

Once a draft implementation schedule is in place, the next step is to estimate the resources required. This will involve estimating both the financial and human resources necessary to implement a food safety plan.

Costs may be one time or recurring. For example, one-time costs may include upgrades to your facility and equipment or the cost of hiring a consultant to guide development and implementation of the food safety plan.

Others costs will be ongoing. They may include employee training, additional time for recordkeeping, or the additional costs of cleaning and sanitizing chemicals.

The costs for every facility will be different. Costs will depend on:

- The state of the facility and equipment
- The number of products being produced
- The complexity of the manufacturing process
- The number of potential food safety problems that should be addressed.

Once the required resources have been identified, the implementation schedule can be developed.

**6. Develop and implement GMPs**

The next step is to develop and implement GMPs that control hazards associated with facility personnel and the sprout processing environment. Each GMP and its standard is outlined in this guidebook. (The OMAFRA *HACCP Advantage Program Manual,* may also be used). This manual may be accessed at: www.omafra.gov.on.ca/english/food/inspection/haccp/haccp_pdf/haccpadvprgmanfinal.pdf; or call toll free 1-866-641-3663 or e-mail HACCP.advantage@ontario.ca to receive a free copy.

Start by reading this guidebook (or just a section in this guidebook to make things easier), then review the current conditions in your facility and compare them to the described standards. You may be surprised to discover that much of what you're already doing meets the requirements of an effective food safety program. Any differences between the standard and the conditions in your plant should be addressed.

For example, compare each of the standards in the Environmental Controls (Section 4) to your premises, building and equipment. If there are shortcomings in your facility, complete the necessary upgrades. Sometimes short-term measures can be taken to meet the standard until permanent long-term fixes are made. For example, short-term operational fixes may include additional procedures to overcome facility deficiencies. (e.g., assign someone to squeegee pooled water until a new floor is installed.)

Once you become familiar with the environmental and operational criteria, do a self-assessment of your operation. The Self-Assessment forms are in Section 9. Compare where your operation is with where it should be (a gap analysis). Pick one area (e.g., sanitation) that needs attention. Revise your procedures in that area to meet accepted GMP standards. Train or retrain your employees until they meet those new procedural standards. Monitor and record the results. Then do another self-assessment in that area to measure your progress.

Once you have one operational or environmental area up to accepted GMP standards, address the needs of another area in the same way. Should you require assistance, OMAFRA has a food safety specialist on staff whom you can contact.

## Why Create a GMP Guidebook

GMP material exists in many different formats and in many different places. Often, descriptions of expectations are vague (e.g., "adequate," "proper") and there are few specifics as to how to achieve "adequate" or "proper." This fragmentation makes it difficult and time consuming for sprout growers to gather all the information necessary to begin a GMP in their facility.

By consolidating food safety explanations, suggestions and options into one document, OMAFRA provides a single reference for sprout producers that wish to initiate a food safety program.

The Good Manufacturing Practices outlined in this manual address food safety issues that a sprouter can control.

**This GMP guidebook is NOT a REGULATION! It is a guide to assist in safe sprout production practices.**

## How to Use This GMP Guidebook

Each chapter in this guidebook is designed to stand alone. The advantage of this format is that a reader can choose any section of the guidebook and access a full discussion of the selected topic. The disadvantage to this approach is that it sometimes creates repetition between sections.

This guidebook is divided into 10 sections:

1. Preface
2. Background
3. Environmental Controls
4. Operational Controls
5. Records
6. Production Controls
7. Control Programs
8. Training Programs
9. Self-Assessment
10. Glossary

The **Background** section discusses the types of contamination commonly found in sprouted seeds and the extent of foodborne illnesses. The rationale for implementation of a food safety program follows, with a description of the components of a full-fledged food safety system completing the section.

The **Environmental Controls** section outlines physical conditions required to create a food-safe environment within a sprout facility. With risk reduction in mind, it begins with the establishment location, describes criteria for facility design and construction, outlines interior facility requirements, discusses equipment design construction and installation, water supply and concludes with a  discussion of facility security.

All sprout growing operations should be conducted in a way that will protect the sprouts from contamination. **Operational Controls** explains the operational conditions that encourage the production of safe food. The standards for food handler hygiene, sanitation, chemical use, equipment maintenance, pest control, water safety, shipping, receiving, storage, recall and traceability are outlined. For example, Sections 4 O1.1 to O1.6 describe hygiene standards including personal hygiene/ practices, hand washing, clothing/footwear/headwear, clothing/ utensil/equipment storage, injuries and wounds, and evidence of illness.

The Environmental Controls and Operational Controls sections follow the format and numbering used by OMAFRA's *HACCP Advantage Program Manual, Version 2.0.* **Each heading in these sections begins with the *GMP Advantage* standard.** The remainder of each section provides suggestions and options as to how to achieve the standard required by *GMP Advantage*.

Each section of the Environmental and Operational Controls first describes the expected outcome or requirements as described in the *HACCP Advantage Program Manual, Version 2.0.* See example below.

For **E4.1 Equipment Design, Construction, and Installation**

**To prevent or minimize sprout contamination, you should meet these requirements:**

- Equipment and utensils that may impact on food safety are constructed of non-toxic materials, exhibit no signs of degradation that could contaminate food, and are easy to clean, sanitize and maintain.
- Equipment design, location, construction and installation promote effective assessment, maintenance, and cleaning and sanitizing activities.
- Adequate equipment or facilities are available for the activities conducted to protect the safety and suitability of food. Equipment functions in accordance with its intended use.

To achieve these requirements, this guidebook goes on to give specific suggestions regarding food contact surfaces, equipment construction and equipment installation as described below.

**This is how to meet these requirements:**

Equipment should be designed, constructed, and installed so that it performs its intended function; is accessible for cleaning, sanitizing, maintenance and inspection; and minimizes the potential for biological, chemical, and physical contamination during operations, etc.

Record keeping is an important component part of an effective GMP program. The section on **Records** discusses due diligence, the importance of recording keeping and types of records.

Sprouted-seed operations should be conducted in a way that will prevent, minimize or control contamination of seed, packaging materials, growing sprouts and packaged sprouts.

In order to produce safe sprouts, only pathogen-free seed should be sprouted. The **Sprout Production Controls** section details each of the steps that should be followed to ensure that only safe seed is used. The discussion of how to effectively sample and test seed for pathogens before sprouting is particularly important. The section also discusses sprouting from the pregermination soak through to the essential immediate rapid cooling of harvested sprouts. **From a safe-sprouts perspective, this may be one of the most important sections in this manual.**

# Preface

To ensure consistent implementation of food safety practices, policies and procedures, Standard Operating Procedures (SOPs) and Sanitation Standard Operating Procedures (SSOPs) should be developed and documented. This documentation is addressed in the **Control Programs** section. To ensure that procedures are executed properly, workers should be trained, which is discussed in the **Training** section.

To help identify GMP compliance in a facility, this guidebook contains a generic **Self-Assessment** in Section 9 in which an operation can be evaluated against generally accepted standards/requirements. This self-assessment begins with a series of statements outlining the accepted standard for each operational and physical area of a facility. Give each area a 1 to 5 rating against that standard. At the conclusion of each section, total the points and calculate a percentage. These scores will help identify risk areas, provide direction for corrective action, and point out documentation and training needs.

Obviously, not every situation encountered by individual sprout growers can be addressed in this guidebook, nor will every procedure suggested apply to every sprouter. However, by using a combination of procedures outlined in this manual and judgment appropriate to the circumstance, sprouters can create conditions favourable for the production of safe sprouts.

# BACKGROUND

## Food Safety Is Everyone's Business

The nutritional and medicinal benefits of sprouts have been recognized for more than 5,000 years. Through the miracle of germination, sprouting converts seeds into a delicious, easy-to-digest food containing vitamins, minerals, enzymes, anti-oxidants and disease-fighting phytochemicals.

Unfortunately, eating raw sprouts has been implicated in a number of foodborne disease outbreaks caused by several strains of *Salmonella* and by *Escherichia coli* (*E. coli*) O157:H7. Since 1995, there have been six outbreaks in Canada (Table 1), as well as several sprout recalls by the Canadian Food Inspection Agency (CFIA). As a result, both Health Canada and the Centers for Disease Control and Prevention in the United States recommend that young children, the elderly, and those with weak immune systems not eat raw sprouts. Outbreaks, recalls and warnings all have a negative economic impact on individual sprouters and on the industry as a whole.

A 2002–03 survey conducted by the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) estimated annual sprout production in Ontario at eight million kilograms. Of that total, by weight, 97 per cent were mung bean and soybean sprouts. The remainder of Ontario-grown sprouts comprise alfalfa, radish, sunflower, wheat, pea, and other seeds.

All food producers, including those in Ontario's seed-sprouting industry, have an obligation to produce and sell food that is both safe and of high quality. Traditional production practices may no longer be adequate to meet society's increasing food safety and quality expectations. Consumer confidence in the safety and quality of Ontario-grown food and the long-term viability of Ontario's producers will be secure only if everyone in the industry is proactive regarding food safety and quality issues.

Throughout food production, processing and distribution, disease-causing, toxic or other harmful hazards may be introduced into the food supply. These hazards may be biological, chemical or physical. Eating food containing any of these hazards may result in illness or injury.

## Types of Sprout Contamination

Bacteria, moulds, parasites and viruses are everywhere in the environment. Some of these microorganisms are beneficial to humans and many are harmless. However, others, known as pathogens, have the potential to cause foodborne illness.

More than 250 known diseases are transmitted through food by biological hazards. *Salmonella* and *E. coli* have been identified as causes of foodborne illnesses resulting from consumption of fresh sprouts. As indicated in Table 1 on the next page, thousands of people have become sick and some have died from eating contaminated sprouts.

While growing in the field, seeds used for sprouting can become contaminated with either *E. coli* 0157:H7 or *Salmonella* by raw manure or irrigation water contaminated with human and animal wastes. During seed handling, cross-contamination can occur from contact with contaminated equipment, seed and/or human hands. There may also be direct fecal contamination by pests such as birds, rodents or insects during handling or growth. *E. coli* 0157:H7 or *Salmonella* contamination of equipment, workers' hands, water, and/or packaging can also cross-contaminate sprouts during harvesting and/or packing.

For additional information about *Salmonella and E. coli* visit the CFIA Web site for the following fact sheets:

- *Salmonella* Food Safety Facts at: www.inspection.gc.ca/english/fssa/concen/cause/salmonellae.shtml
- *E. coli* Food Safety Facts at: www.inspection.gc.ca/english/fssa/concen/cause/ecolie.shtml

**Table 1: Selected Outbreaks and Recalls Associated with Sprouts**

| Date | Type of Sprout | Pathogen | Area of Outbreak* or Recall** | Number of Cases | Ref. |
|---|---|---|---|---|---|
| 1994 | alfalfa | *Salmonella* Bovismorbificans | Sweden Finland | 595 | 1, 3, 4 |
| **1995** | **alfalfa** | ***Salmonella* Newport** | **Oregon and British Columbia (133), Denmark (150)** | **283** | **1, 3, 4** |
| 1995 | alfalfa | *Salmonella* Stanley | 17 US states (128) Finland (114) | 242 | 1, 3, 4 |
| 1996 | alfalfa | *Salmonella* Montevideo and *S.* Meleagridis | 2 US states including California | 500 | 1, 3, 4 |
| 1996 | radish | *Escherichia coli* 0157:H7 | Japan | 6,000 | 1, 2, 3, 4 |
| **1996** | **alfalfa** | ***Salmonella* Newport from seed** | **British Columbia, Quebec** | **60** | **2, 3** |
| 1997 | alfalfa | *E. coli* 0157:H7 | Michigan (60) , Virginia (48) | 108 | 1, 3 |
| 1997 | radish | *E. coli* 0157:H7 | Japan | 96 | 1, 3, 4 |
| 1997 | radish | *E. coli* 0157:H7 | Japan | 126 | 1, 3, 4 |
| **1997** | **alfalfa** | ***Salmonella* Meleagridis** | **Ontario, Alberta, Saskatchewan** | **78** | **1, 3, 4** |
| 1997 | alfalfa, mung, others | *Salmonella* Infantis and *S.* Anatum | Kansas, Missouri | 109 | 1, 3, 4 |
| 1997–98 | clover and alfalfa | *Salmonella* Senftenberg | California, Nevada | 60 | 1, 3, 4 |
| 1998 | clover and alfalfa | *E. coli* 0157:H7 | California | 8 | 1, 3, 4 |
| 1998 | alfalfa | *Salmonella* Havana, *S.* Cubana, *S.* Tennessee | Arizona, California, New Mexico, and 2 other states | 40 | 3, 4 |
| 1998 | alfalfa | *Salmonella* Havana from seed | California (14), Arizona (4) | 18 | 1, 3 |
| **1999** | **alfalfa** | ***Salmonella paratyphi B var Java*** | **Alberta (43), British Columbia (6), Saskatchewan (2)** | **51** | **3** |
| 1999 | alfalfa | *Salmonella* Mbandaka | Oregon, Washington, Idaho, California | 75 | 1, 3, 4 |
| 1999 | clover | *Salmonella* Saintpaul | California | 26 | 1, 3 |
| 1999 | alfalfa | *Salmonella* Muenchen | Multistate | ~157 | 1,3,7 |
| 1999 | clover, alfalfa | *Salmonella* Typhimurium | Colorado, Connecticut | 90 | 3, 4 |
| 2000 | bean | *Salmonella* Enteritidis PT 4b | Netherlands | 25 | 3 |
| **2000** | **mung bean** | ***Salmonella* Enteritidis PT 11** | **Alberta, Saskatchewan** | **10⁺** | **3** |
| 2000 | sprout products | *E. coli O157:H7* | California | Recall | 3 |
| 2000 | mung bean | *Salmonella* Enteritidis PT33 | California | 45 | 1, 3 |
| 2001 | alfalfa | *Salmonella* Kottbus | California (24), Arizona (6), Colorado (1), New Mexico (1) | 32 | 1, 3, 5 |

**Table 1: Selected Outbreaks and Recalls Associated with Sprouts** continued

| Date | Type of Sprout | Pathogen | Area of Outbreak* or Recall** | Number of Cases | Ref. |
|---|---|---|---|---|---|
| **2001** | **mung bean** | ***Salmonella* Enteritidis PT913** | **Alberta , British Columbia, Saskatchewan** | **84** | **3** |
| 2001 | mung bean | *Salmonella* Enteritidis PT1 | Hawaii | 26 | 4 |
| 2001 | mung bean | *Salmonella* Enterididis PT913 | Florida | 35 | 4 |
| **2002** | **alfalfa, radish and blends** | ***Salmonella*** | **Canada** | **Recall** | **3** |
| 2002 | alfalfa | *Listeria monocytogenes* | Alabama, Georgia, Kentucky, Tennessee | Recall | 3 |
| 2002 | alfalfa | *E. coli* O157:H7 | California, Nevada | 5 | 1 |
| **2003** | **alfalfa , alfalfa blends** | ***Salmonella*** | **Ontario, Quebec, Atlantic Provinces** | **Recall** | **5** |
| 2003 | alfalfa | *E.coli* O157:H7 | Minnesota | 5 | 6 |
| 2003 | alfalfa, alfalfa blends | *Salmonella* Saintpaul | Oregon, Alabama, Washington, Idaho, Alaska | >9 | 3 |
| 2003 | alfalfa | *Salmonella* Chester | Oregon | 24 | 1 |
| 2003 | alfalfa | *E. coli* O157:NM | Colorado, Wyoming | 13 | 1 |
| 2004 | alfalfa | *E. coli* O157:NM | Georgia | 5 | 1 |
| 2004 | alfalfa | *E.coli* O157:H7 | Florida | Recall | 1 |
| 2004 | alfalfa | *Salmonella* Bovismorbificans | Oregon, California, Montana, Idaho, Alaska, Washington, Nevada | Recall | 1 |
| **2005** | **mung bean** | ***Salmonella*** | **Ontario** | **~ 600 Recall** | **5** |

1. U.S. Federal Drug Administration
2. Health Canada
3. OMAF Food Industry Division Risk Profile
4. Centers for Disease Control and Prevention
5. Canadian Food Inspection Agency
6. Minnesota Department of Health
7. *Journal of Clinical Microbiology* 39 (2001), p. 3461

* A foodborne disease outbreak is defined as an incident in which two or more people experienced a similar illness after ingestion of a common food.

** Recalls were deemed to be for food safety concerns.

Infected food handlers may introduce viruses such as Hepatitis A, noroviruses and rotaviruses into food. Moulds growing on the ceilings of coolers, production and packaging areas can produce chemical mycotoxins, some of which are toxic enough to cause acute or chronic illness if consumed. To further complicate the issue, scientists continue to discover previously unknown pathogens.

Some chemical contaminants occur naturally; others are a result of environmental contamination. Allergens are substances in food (e.g., peanuts) that can cause some individuals to have an allergic reaction. Some micro-organisms produce mycotoxins (e.g., aflatoxin, patulin). All can be hazardous to human health.

Chemical contaminants may also be added during agricultural production or sprout production. Added chemicals may come from pesticides, fertilizers, lubricants, cleaners, sanitizers, pest control products and many other sources. Food additives or processing aids at levels over the prescribed limit are also chemical contaminants. **Ingestion of certain chemicals or combinations of chemicals can cause chronic illness or even death.**

Physical contaminants such as glass, metal, wood and plastic fragments can injure those inadvertently consuming them. These contaminants can enter the sprouts via seeds, and during sprouting, harvesting, packaging, storage or transportation.

### Extent of Foodborne Illness - *Canada*

Estimating the extent of foodborne illness is an inexact science. Scientific methodology, statistical analysis, commodity groupings, and a host of other factors usually differ from study to study so an apples-to-apples comparison is often impossible. This should be kept in mind while reviewing any studies, including those that follow.

OMAFRA's Food Safety Science Unit (FSSU) estimates[1] that 41 per cent of foodborne illness in Ontario can be attributed to foods of plant origin. This exceeds every other food group including meat, fish, dairy and eggs. On average, FSSU estimates that foods of plant origin caused 90,200 illnesses annually from 1997 to 2001. The estimated annual health-related cost (health care, lost wages and other economic losses caused by illness) resulting from these foodborne illnesses was $143,591,577, second only to foodborne illness costs associated with meat.

During the same period, studies in the United States estimated produce-related illness outbreaks at 12 per cent of the total food-related outbreak total.

A report published in the June 2003 *Journal of Food Protection* offers insight into the relationship between intestinal illnesses in Ontario and food

[1] With 90 per cent confidence.

contamination. The report, titled *Enteric Illness in Ontario, Canada, from 1997 to 2001,* identifies foodborne contamination as the mode of transportation for 74.0 per cent (14,580) of the outbreaks caused by eight enteric pathogens. (Enteric pathogens affect the intestines.) Foods of plant origin accounted for 31.6 per cent of the contaminated food investigated in the report.

The *Enteric Illness* report concluded that there appears to be a downward trend in the number of eight enteric diseases studied in the 1997–2001 period compared to the previous 1992–1996 five-year period. Despite an increase in population, the number of cases from 1997 to 2001 (44,451) was fewer than the number of cases reported from 1992 to 1996 (56,690). No reason for this decline was offered. In all foods, *Campylobacter* was the leading cause of illness in Ontario in both five-year periods, followed by *Salmonella*, VTEC (verotoxin *E. coli*), *Yersinia*, *Shigella*, Hepatitis A, *Listeria*, and *Clostridium botulinum*. There were 113 foodborne illness–related deaths in Ontario between 1997 and 2001. The report cautions, "Although the incidence of these enteric diseases appears to be declining, the potential remains for occurrences of large outbreaks resulting from a pathogen having contaminated a widely distributed food product or a large water distribution system" (p. 956).

### Extent of Foodborne Illness *- United States*

Using statistics derived from the U.S. Centers for Disease Control, the Center for Science in the Public Interest (CSPI) linked 554 illness outbreaks involving 28,315 illnesses to produce between 1990 and 2003. Twenty-four per cent of these produce-related outbreaks were caused by salads, 18 per cent by produce dishes, 16 per cent by vegetables other than those listed below, 10 per cent by fruits other than those listed below, 8 per cent by lettuce, **5 per cent by sprouts**, 5 per cent by potatoes, 5 per cent by melons, 3 per cent by mushrooms, 3 per cent by berries, and 3 per cent by home-canned vegetables. Produce accounted for more foodborne illness than seafood, poultry, beef or eggs.

The Foodborne Diseases Active Surveillance Network's report, titled *Preliminary FoodNet Data on the Incidence of Infections with Pathogens Transmitted Commonly through Food—Selected Sites, United States, 2003*, States,[2] "For most pathogens, the 2003 incidence of infection was lower than the average annual incidence for 1996–1998." It also notes that "the changes in the incidence of these infections occurred in the context of control measures implemented by government agencies and the food industry, enhanced food safety education efforts, and increased attention by

[2] *CDC Morbidity and Mortality Weekly Report*, 53 (16) (April 30, 2004), p. 340.

consumer groups and the media" (p. 341). In other words, food safety programs, including changes in regulation, education and improved technology, are positively impacting food safety.

Reiterating concerns expressed in other reports, the *Preliminary FoodNet Data*[3] report suggests that "efforts also should include steps to reduce contamination of fresh produce. The high incidence of several of these infections in infants and young children is of major concern."

Centers for Disease Control and Prevention (CDC) scientists in the United States warn against relaxing food safety efforts. The true number of foodborne illnesses is not known because of an undetermined amount of underreporting. (The CDC estimates that only one of every 37 foodborne illnesses is reported.). Mass production, widespread distribution and increased importation enable pathogens to spread more rapidly and broadly through the population than in times of local production and distribution. Scientists have been unable to determine the causes of a portion of foodborne illnesses possibly because they are caused by unknown pathogens.

## Reducing Risk

No food product can ever be entirely risk free. The risk associated with consumption of any food depends on the quantity of contamination consumed, the strength (toxicity) of the contaminant involved and the susceptibility of the individual(s) consuming the contaminant (e.g., age, level of health, status of immune system).

Although the overall number of foodborne illnesses declined during the last five-year period, the number of foodborne illnesses in fruits and vegetables has increased. In large part, this increase is due to the greater level of consumption of whole and minimally processed fruits and vegetables, changes in consumer demographics, and more intensive production, processing and handling practices.

## Implementation Rationale

Consumers and governments expect our food to be safe. Their expectations are not negotiable.

Traditionally, final product sampling has been used to identify suspect product. However, when pathogens are present, they are often randomly distributed at low levels, so they are extremely difficult to detect. This makes the cost of statistically valid sampling programs uneconomical. An example used by Dr. James Gorny of the United Fresh Produce Association

[3] *CDC Morbidity and Mortality Weekly Report*, 53 (16) (April 30, 2004), p. 342

illustrates this point. According to Dr. Gorny, if pathogens are present on 5 per cent of the final product, in order to have a 95 per cent probability of finding that contaminated 5 per cent, 60 per cent of the final product must be tested. This involves prohibitive costs, and the testing process is often painfully slow.

Because there are no known processing procedures that will completely eliminate contamination in sprouts, and because final product-testing programs are slow, costly and ineffective, universally recognized prevention systems have been developed to minimize the risk of hazard introduction.

## Food Safety Programs

Food safety programs are preventive systems designed to detect potential hazards before they occur and to implement control measures to reduce or eliminate the likelihood of their occurrence. Food safety programs may be divided into three general areas. They are:

- Good Agricultural Practices (GAPs)
- Good Manufacturing Practices (GMPs)
- Hazard Analysis Critical Control Points (HACCP)

(Refer to the "Components of a Food Safety System" summary at the end of this section).

The first of these proactive systems is the application of **Good Agricultural Practices (GAPs)** during growing, harvesting, on-farm transportation, packing and storage. Examples of programs for specific commodities may be accessed through the Canadian Horticultural Council (CHC). Excellent programs have also been developed by Cornell University, the University of California Davis (UC Davis) and the United States Food and Drug Administration (USFDA). GAPs may be developed as a stand-alone program. These programs for produce growers are currently voluntary.

At the processing level, **Good Manufacturing Practices (GMPs)** are the basic, universal conditions and procedures within the processing establishment that create conditions favourable for the production of safe food. GMP requirements are largely common-sense practices. They include all physical aspects of the production facility environment, as well as operational management of food handler hygiene, sanitation, chemical use, equipment maintenance, pest control, water safety, shipping, receiving, storage, recall procedures, traceability and facility security procedures. None are process specific. As with GAPs, GMPs may be developed as a stand-alone program. These programs for foods of plant origin

processors/producers are currently voluntary. However, processors/producers may choose to undergo a Canadian General Standards Board (CGSB) audit to become *GMP Advantage* certified. The Food Safety Program Accreditation section discusses certification in more detail.

**Standard Operating Procedures (SOPs)** and **Sanitation Standard Operating Procedures (SSOPs)** are an essential part of GMPs. SOPs are detailed documents that specifically define how procedures will be performed. SSOPs are the written procedures that describe step-by-step cleaning and sanitation procedures required in a GMP sanitation program. Both include who, what, where, when and why. Each is tailored to individual operations as part of the operation's food safety plan.

**Hazard Analysis Critical Control Points (HACCP)** is the final step in implementation of food safety practices in an operation. **HACCP is not a stand-alone program.** Only after a GMP program is in place can a HACCP plan be prepared. During the development of a HACCP plan, potential biological, chemical and physical hazards are identified in the manufacturing process. Control and monitoring measures are then implemented at these critical control points (CCPs) to ensure that the identified hazards are reduced, prevented or eliminated. Actions taken are recorded.

Worldwide acceptance and recognition of HACCP as a method for food safety assurance increased dramatically with publication of the *Guidelines for the Application of Hazard Analysis and Critical Control Points System* by the Food and Agriculture Organization (FAO)/World Health Organization (WHO) Codex Alimentarius Commission in 1993. Since then, as HACCP has gained worldwide acceptance, the Codex Alimentarius Commission has continued to refine the HACCP system and guidelines for its application.

For additional information regarding good practices, sprout growers may also access the Canadian Food Inspection Agency's *Code of Practice for the Hygienic Production of Sprouted Seeds* (2001) at: www.inspection.gc.ca/english/plaveg/fresh/safsal/sprointe.shtml.

*Health Canada's Policy on Managing Health Risk Associated with the Consumption of Sprouted Seeds and Beans* may be found on the Health Canada Web site at:
shttp://hc-sc.gc.ca/fn-an/securit/ill-intox/info/sprouts-pousses_e.html

The International Sprout Growers Association (ISGA) is also an excellent source of sprout safety information for sprouters that are members.

## Food Safety Program Accreditation

Until recently, only federally registered food processors/producers could gain HACCP accreditation through the Canadian Food Inspection Agency's Food Safety Enhancement Program (FSEP). However, OMAFRA has designed a HACCP program for non-federally registered food processors called *HACCP Advantage*. It was introduced in 2003.

The voluntary *HACCP Advantage* program is designed to be feasible regardless of the size, commodity or volume of production of an operation. It complements food safety regulations but does not replace them.

As of March 1, 2006, food processors/producers that wish to have their *HACCP Advantage* program certified by the Canadian General Standards Board (CGSB) have three options:

- *GMP Advantage*: CGSB certification that the requirements for environmental controls, control programs, operational controls and training have been met. For many foods of plant origin processors/producers, this may be all that is required.
- *HACCP Advantage*: Certification includes requirements of the *GMP Advantage* program plus a HACCP plan, as outlined in the *HACCP Advantage* guidebook.
- *HACCP Advantage Plus+*: To achieve certification, requirements of *GMP Advantage*, *HACCP Advantage*, four standards relating to Traceability, and eight standards relating to Security must be achieved.

This *Sprouted Seeds GMP Guidebook* is consistent with the format of the *GMP Advantage* program. This publication is designed to address challenges specific to sprouting operations. OMAFRA recommends that all sprouting operations implement the programs described in this publication, regardless of whether or not they plan to seek formal *GMP Advantage* certification.

## The Economics

The benefits of food safety programs are many. Some are tangible financial rewards, while others are less easily measured.

Implementation of effective food safety and quality control programs requires critical examination of every aspect of facility environment and operations. This greater level of control generally leads to enhanced production efficiencies including higher production levels, increased yields resulting from less product waste, less product rework, a more consistent product and increased shelf life. Less easily measured is the financial and emotional impact of fewer crises and freed management time. Other benefits include less chance of financial loss caused by unsafe product, and increased credibility with buyers with the resulting potential for larger market share.

Obviously, certain costs are involved in the implementation of a food safety program. Some will be one-time costs (e.g., facility and/or equipment upgrades, developing and implementing programs) and some will be recurring (e.g., training, monitoring and record keeping). The number of products, the complexity of the processing procedures and the number of potential food safety hazards to be addressed also affect cost.

Ongoing economic studies suggest that long-term financial benefits of a GMP program generally outweigh the added costs. Therefore, an effective GMP program should be considered an investment in the business, not a cost of doing business.

## Components of a Food Safety System

**Good Agricultural Practices** (GAPs) *Practices used in the growing, harvesting, sorting, packing and storage operations of the seed to reduce contamination.*

↓

**Good Manufacturing Practices** (GMPs) (also called Prerequisite Programs) *Basic, universal conditions and procedures within the sprouting establishment that create conditions favourable for the production of safe food. They control general hazards.*

**Environmental Controls**
- Establishment Location and Construction
- Establishment Design
- Establishment Interior
- Equipment
- Water Supply
- Security

**Operational Controls**
- Personnel Hygiene/Practices
- Shipping, Receiving, Handling and Storage
- Sanitation
- Equipment Maintenance
- Pest Control
- Recall
- Water Safety
- Traceability
- Security

**Control Programs** (written policies and procedures)
- Personnel Hygiene/Practices
- Shipping, Receiving, Handling and Storage
- Sanitation
- Equipment Maintenance
- Pest Control
- Recall
- Water Safety
- Traceability
- Security

**Training**
- Personnel Hygiene/Practices
- Shipping, Receiving, Handling and Storage
- Sanitation
- Equipment Maintenance
- Pest Control
- Recall
- Water Safety
- Traceability
- Security

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**HACCP** *A worldwide recognized, science-based, preventive system designed to detect potential hazards before they occur and to implement control measures to reduce or eliminate* the likelihood of their occurrence.

# E1 ESTABLISHMENT LOCATION and CONSTRUCTION

## E1.1 Property and Surroundings

**To prevent or minimize sprout contamination, you should meet these requirements[1]:**

- The establishment is located away from or protected against potential sources of external contaminants that may compromise the safety and suitability of food.
- Areas surrounding the establishment are maintained to prevent or minimize harbourage of pests and contaminants.

**This is how to meet these requirements:**

**Location** Ideally, sprout facilities should be located away from areas where atmospheric dust (e.g., dust from parking lots, driveways or fields), smoke, objectionable odours (e.g., industrial manufacturing facilities or intensive livestock operations), airborne chemicals (e.g., pesticides or industrial pollutants) or vehicle exhaust pollution are present. Any of these pollutants may enter the facility and contaminate food, food contact surfaces or food packaging materials with microorganisms, chemicals, dirt or other extraneous material. Environmentally polluted locations (e.g., old landfill or toxic waste sites) should also be avoided as building locations. Areas that are prone to infestations of pests (e.g., sites near swampy areas) should not be considered as building sites, nor should areas that are likely to flood.

**Drainage** Standing water may result from poor drainage or occasional flooding of grounds, driveways or parking lots. This water may promote the proliferation of insects (e.g., breeding area for mosquitoes) and pests (e.g., source of drinking water for rodents, birds including seagulls and pigeons, raccoons, or reptiles). Standing water also encourages microbial contamination by generic *E. coli* that may be carried into the facility on mud and dirt by foot traffic, equipment or pallets. In addition, control of exterior water minimizes the potential for contamination by seepage into the facility.

[1] All "standards" statements in this guidebook reflect "What Is the Standard?" as described in the *HACCP Advantage Program Manual, Version 2.0.*

**Grounds Maintenance**

Grounds should be maintained. Debris, garbage, unused equipment, pallets, containers, tall vegetation and raw materials stored outside the facility encourage breeding and harbourage of pests such as mice, rats, raccoons, insects, birds, skunks, snakes and other wildlife. All may enter the building and contaminate sprout production, harvesting or packaging areas.

Vegetation surrounding the facility should be kept closely trimmed to a distance of at least 6 m (20 feet) from the facility. Garbage and other debris should be picked up immediately and placed in covered, pest resistant containers.

Supplies and equipment stored outside the building should be neatly stacked, elevated at least 15 cm off the ground, or stored on concrete slabs and located at least 6 m from the facility to discourage rodent and insect harbourage. Pipes stored within 6 m of the facility should have the ends sealed to prevent pest entry.

**Pest Deterrents**

Mice and rats are discouraged by open spaces. A strip of vegetation-free, debris-free gravel a minimum of 75 cm wide and 10 cm deep around the perimeter of the production facility will discourage rodent entry. The wider the perimeter strip, the better. This strip is also an excellent location for traps and bait stations. (See Section O5.1 for more details regarding pest control.)

Minimize roosting and nesting sites on and near the production facility to discourage birds.

Outside lights should be located on standards away from the facility, not on the building. This will minimize insects swarming near open doors and windows after dark. Insects are less attracted to lights containing low ultraviolet levels.

Solid and liquid wastes should be stored in non-leaking, covered containers placed on concrete slabs. Exterior waste containers should be located far enough from the production facility to discourage rodent travel between the two. Frequent emptying of waste containers will minimize their appeal to pests (e.g., rats, mice, flies, gulls, etc.) and reduce odours. Areas around waste containers should be kept clean to make the area less attractive to pests and to minimize the potential for cross-contamination (e.g., on wheels of forklifts, shoes, etc.).

**Roadways** Paved driveways and parking areas are ideal. Where this is not possible, roadways should be properly graded, compacted and free of dust. Dust from unpaved driveways may be controlled with environmentally friendly dust suppressants (e.g., Tembec Dust Supressant®, a non-toxic, biodegradable ammonium lignosulphonate pulping liquor). Calcium chloride is the most commonly used dust suppressant, and petroleum mixtures are also effective, but both are less environmentally safe. The Ministry of the Environment must approve all dust suppressants used in Ontario.

Paved grounds and driveways should be swept (or washed down regularly) to prevent dust and other potential contaminants from blowing into the building and transport vehicles. For large areas, a street sweeper can be an effective tool.

## E1.2 Building Exterior

**To prevent or minimize sprout contamination, you should meet these requirements:**

- Establishment exterior is structurally complete and suitable for the operations taking place within.
- Establishment exterior is protected against entry or harbourage of pests as well as entry of external contaminants.

**This is how to meet these requirements:**

**Structure** Regardless of whether the facility is new or renovated, the exterior should be constructed of durable, weather-resistant materials. It should also be structurally sound and in good repair.

The design and construction of all facilities must conform to local building regulations. Information about the Ontario Building Code, the latest Code developments, and advice on interpreting Code requirements may be found at: www.obc.mah.gov.on.ca/scripts/index_.asp.

**Pest Deterrents** Openings in walls, foundations, eves and the roof should be screened or sealed, as appropriate, to prevent entry of the outside elements (e.g., rain or snow), airborne contaminants (e.g., dust, smoke or odours), and pests (e.g., mice, pigeons or raccoons). Facility design and construction should also discourage harbouring of insects, birds, rodents and other vermin by minimizing exterior ledges, and nooks and crannies where pests can feed, nest, travel and hide.

Facility doors and windows should be kept closed. When this is not possible, they should be screened (22 mesh or finer is suggested). All doors and windows should be tight, with cracks not exceeding 6 mm in height or width. Doors opening to the outside should be equipped with brush seals and should be fitted with self-closing devices. The use of air curtains provides extra protection against pest entry.

Dock doors should be kept closed to prevent bird, rodent and insect entry. Brush seals on dock leveller plates will discourage rodent entry. Dock canopies should be designed and constructed to deter birds roosting and nesting. Areas near the dock should be kept free of debris and spilled products. Dock door seals will prevent potentially contaminating runoff water from truck and trailer roofs entering the facility or dripping on product or raw materials as they are loaded or unloaded.

Exposed outside drains should be screened to prevent pest entry into the facility.

**Security**

Security at food production facilities has recently received increased attention, especially in the United States. In some circumstances, improved security measures may be necessary to prevent entry of visitors who may intentionally or unintentionally contaminate product. This may require a policy of new employee screening, restricted visitor entry, employee identification badges, a facility security system, perimeter fencing, exterior lighting, or other measures. A more detailed discussion on security may be found in section E6 Secuirty.

# E2 ESTABLISHMENT DESIGN

## E2.1 Cross-Contamination Control

**To prevent or minimize sprout contamination, you should meet this requirement:**

- Establishment design or operational controls permit hygienic activities, including protection against cross-contamination of food, ingredients, packaging materials and food contact surfaces.

**This is how to meet the requirement:**

In simple terms, cross-contamination control means controlling the transfer of microbial, chemical and physical hazards **into** the facility and controlling the transfer of microbial, chemical and physical hazards from one area to another **within** the facility. This can be accomplished by facility design and by controlling movement of people and materials in the facility.

**Separation**

Facility design should separate incompatible operations to minimize the potential for cross-contamination between ingredients, food contact surfaces, packaging materials and finished food products. This may be achieved by:

- Physical separation
    - Separate rooms for seed storage, production, packaging and chemicals used for cleaning and sanitation, or
    - Adequate physical separation of designated work areas to prevent cross-contamination.
- Operational separation
    - Scheduling incompatible operations at different times with sufficient time between operations to clean and sanitize, or
    - Using dedicated equipment.

Physical separation of operations is the preferred option over operational separation.

The following is an example of physical separation in a sprouting facility.

There should be distinct areas within the facility:

1. An area for receiving supplies. The food-related supplies (e.g., seed/packaging) and non-food supplies (e.g., cleaning and sanitizing chemicals) should be received at different times with a cleanup period separating the receiving times.

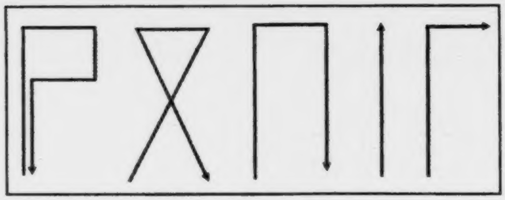
2. A room or area dedicated to storing seed. Seed should be carefully stored to ensure that it does not become contaminated or become a potential source of contamination.
3. Another room or area dedicated to storing non-food-related supplies.
4. Possibly another dedicated room or area for rinsing and sanitizing seed.
5. A production room or area committed to germinating seed.
6. A room or area used strictly for packaging activities (hulling, drying and packaging).
7. A cooler (or as a bare minimum, a designated area in a cooler) devoted to the storage of sprouts at the appropriate temperature.
8. A shipping area for shipping sprouts different from the receiving area. This may take the form of different shipping and receiving docks. Where this is not feasible and the same area is used for both shipping and receiving, great care should be taken to avoid cross-contamination with incoming supplies (e.g., chemicals) or different outgoing products (e.g., uncooked food products). On a shared dock, shipping/receiving times should be spread out to allow for necessary cleanup between shipments.
9. An area for employee facilities such as washrooms, change room and a separate lunchroom.

**Food Worker Traffic Flow**

Control of employee traffic flow is an effective way to avoid cross-contamination between different production areas. Employee shoes and boots, equipment (e.g., forklifts, handcarts and carts), and transportation devices (e.g., pallets, bins, etc.) may be a serious source of microbial, chemical or physical contamination. Therefore, worker traffic flow should be designed to minimize the risk of cross-contamination between different production areas.

For example, a worker who handles bags of seed should not be allowed to walk into the packaging area or to handle sprouts. This avoids the potential transfer of pathogens found on bags and seeds to the sprouts. Whenever possible, this worker should be allowed into the sprouting area only after changing into clean clothes and headwear, and sanitized footwear, and performing a thorough handwashing.

Traffic flow should be designed in such a way that employees do not pass through other production areas to get to their designated area. Poor to best traffic flow is illustrated in the following example:



Poor Poor Better Best Best

Ideally, employees should enter their designated work area from a change room or common hallway and pass through a foot sanitizer. Where direct entry is impossible, traffic flow should always be from "cleaner" areas to "dirtier" areas. To facilitate traffic flow in the opposite direction, ("dirty" to "clean"), facility design should incorporate areas where employees can change clothes between production areas. Facility design should also provide foot baths or sanitizing floor foamers at each entrance and an adequate number of strategically placed handwashing stations.

The flow of people and product and potential points of cross-contamination can both be identified in a facility schematic or in facility blueprints.

- Identify each work area or room and the position of each piece of equipment.
- Plot the flow of people, ingredients, food products, packaging, chemicals, waste, etc. throughout the facility. Use different coloured arrows or different styles of dashes to distinguish the flow of each.
- Verify the accuracy of your diagram by walking through the facility during production.
- Identify the points of potential cross-contamination (biological, chemical and physical).
- Use the diagram to design improved traffic flow patterns.

It is helpful to identify acceptable employee traffic areas with wall signs or floor-painted routes. Travel in "restricted" areas can be discouraged by physical partition of storage, processing and packaging areas. Except for emergency exits, the number of entry/exit doors should be limited to discourage traffic. Fewer entrances also minimize the expense of additional entrance equipment (e.g., floor foamers) and personnel supplies (e.g., fewer changes of hair nets, gloves, beard covers, etc. are required).

**Flow of Seed/ Packaging/Sprouts**

Flow or movement should always be directly from one production area to the next with no backtracking or crossovers of "raw" products and/or ingredients with finished products. For example, sprouts harvested from the growing room should be taken directly to the packaging area; they should not travel through an area such as a seed storage area. In larger operations, a sealed auger may carry the seed from the storage area to the sanitizing area.

Seed, packaging, cleaning and sanitizing chemicals, etc. should be brought directly from storage areas to the area where they will be used. As with employees, they should not travel through another production area to get there.

**Equipment/Utensil Movement**

The same rules that apply to human traffic patterns should also apply to equipment traffic patterns. Equipment (e.g., forklifts, handcarts and carts) and transportation devices (e.g., pallets, bins, etc.) should be restricted to designated areas. This will lessen the potential for tracking pathogen-containing material from one part of the facility to another. Equipment used for moving ingredients, packaging material and finished product throughout the facility should also be kept clean and maintained in good condition. When passing from "dirty" to "clean" areas, driving through floor foams will help sanitize tires.

Utensils, such as pails that have been used to handle seed, should not be allowed into any other area of the facility. A pail used to handle "dirty" (unsanitized) seed should be clearly marked *For Seed Use Only*, and never be removed from the seed handling area.

**Waste Flow**

Waste should never move through sprout growing, harvesting, packaging or storage areas when there is risk of contamination or cross-contamination with seed, sprouts or packaging. Waste should never pass over sprout packaging lines. To avoid cross-contamination with employees and equipment, care should be taken not to spill waste while emptying containers.

Liquid waste (e.g., wastewater and sewage) systems should be of adequate size to handle operational volumes. Wastewater drainage and sewage systems should be equipped with appropriate traps and vents, fully separated so there are no cross-connections and clearly identified as to their function. These lines should not pass over or through production areas unless stringent precautions have been taken to prevent contamination in the event of leakage. In the event of a backup of wastewater or sewage, the

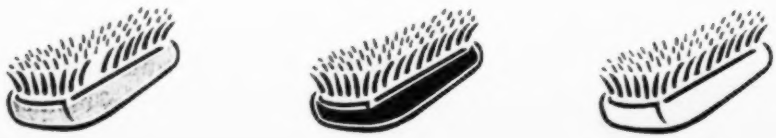
affected areas should be thoroughly cleaned and sanitized before production resumes, and contaminated sprout products, ingredients, and packaging materials discarded.

Drainage and sewage systems are covered in greater detail in Section E3.5.

### Colour Coding

Colour coding is an effective way to reduce the potential for cross-contamination by microorganisms.

Establish an area in which a specific processing step will take place. Designate a colour for all food handling utensils, tools, and employees' gloves and hairnets. Designate another colour (or variation of the food handling colour) for all cleaning and sanitation tools that will be used in that same area. These colours and these colours only should be used in the defined area. Refer to cleaning brush example below.



| **Grey colour** | **Black** | **White** |
| --- | --- | --- |
| - non-product contact surfaces | - drains only | - product-contact surfaces only |

### Utensil Cleaning Area

In order to prevent contamination, cross-contamination, and recontamination, it is necessary to clean and sanitize utensils and reusable plastic bins, and disassemble smaller equipment in a physically separate area or room. This area should be in a location convenient to the production area but one that does not require travel through other production areas to access.

Facility design should allow adequate working space to perform all operations, including cleaning and sanitizing functions.

The walls, floor and ceiling should be constructed of non-absorbent, non-toxic, smooth, corrosion-resistant materials able to withstand repeated cleaning. A list of acceptable materials is published by the CFIA.
The *Reference Listing of Accepted Construction Materials, Packaging Materials and Non-Food Chemical Products* may be accessed at: www.inspection.gc.ca/english/fssa/reference/refere.shtml. The area should be well ventilated. It should be supplied with sufficient quantities of hot and cold water at adequate pressure. Floors should be sufficiently sloped to

allow water to drain to trapped, cleanable drains, and drainage lines should be large enough to carry peak loads of effluent. Design and construction must comply with local building codes.

## E2.2 Personnel Facilities

**To prevent or minimize sprout contamination, you should meet these requirements:**

- Washrooms, change rooms, and lunch and break area(s) are provided and maintained to ensure that personal hygiene can be maintained to protect the safety and suitability of food.
- Washrooms are equipped with adequate lighting and an adequate number of flush toilets and handwashing stations; are free of condensation, excess moisture or odours; and are designed to prevent or minimize contamination.

**This is how to meet these requirements:**

Washrooms, change rooms, and eating areas all should be designed and constructed to permit easy cleaning and sanitation and to encourage personal hygiene. Dirty facilities may unintentionally contaminate food handlers who, in turn, can contaminate seed, utensils, equipment, packaging materials and sprouts.

All personnel facilities should not open directly into sprout production, harvesting or packaging areas, should be equipped with proper ventilation, and should have automatic self-closing doors to minimize hand contact with contaminated knobs and door surfaces.

The floors, walls and ceilings of all washrooms, change rooms and lunchrooms should be constructed of non-absorbent, non-toxic, smooth, corrosion-resistant material that is able to withstand repeated cleaning. (See www.inspection.gc.ca/english/fssa/reference/refere.shtml for a list of acceptable materials.) Floors should slope to functioning drains. If possible, toilets, partitions, sinks and other fixtures should be wall mounted to permit easy and thorough floor cleaning and sanitation. Tables and chairs in change rooms and lunchrooms should be hard surfaced for ease of cleaning. All employee facilities should be cleaned daily.

Handwashing is the single most effective way to prevent the spread of communicable diseases. Sinks should be supplied with potable (suitable for drinking) water in adequate quantity and pressure. If possible, both hot and cold running water should be available with knee, thigh, foot or electric sensor controls so employees are not required to touch the taps after

washing their hands. Where "hands-free" tap controls are not present, employees should close the tap control with their single-use paper towel to avoid direct contact with their clean hands.

Single-use towels are the preferred method of hand drying. The rubbing action required to dry hands with single-use towels also removes microbes from hands. Common-use cloth towels become contaminated quickly and should never be used. Air dryers may recontaminate freshly washed hands with airborne contaminants.

Towel dispensers should be "hands free" so food handlers can pull out paper towels without touching the dispenser. Handwashing notices and instructions in languages appropriate for the employees should be posted in the washrooms.

Each sink should be equipped with liquid soap in a pump dispenser. Where appropriate, a hand sanitizer may also be provided. An adequate number of lined waste receptacles should be present. They should never overflow. Unlined waste receptacles should be cleaned after every emptying to discourage odours and pests.

Washrooms should have an adequate number of sinks and toilets for the number of people using them (a maximum 20 people per toilet is suggested). A fan, exhausting to outside the facility, should be connected to the light switch so when the washroom is in use (the light is turned on), the fan creates negative air pressure within the room. Lighting intensity should be 220 lux (20 foot candles) or greater to facilitate sanitation procedures (you can't properly clean what you can't see). See Section E3.2 for more lighting information.

As noted earlier, the design and construction of all facilities must conform to local municipal building regulations and the Ontario Building Code. Information about the Ontario Building Code, the latest Code developments, and advice on interpreting Code requirements may be found at: www.obc.mah.gov.on.ca/scripts/index_.asp.

Ideally, washrooms should be located only in break areas and separated from production areas so doors do not open directly into a production /harvesting/packaging area. Preferably, doors should be self-closing so employees do not have to touch them after washing their hands. There should be an adequate number of hangers outside the entrance so that employees can remove protective clothing (aprons, gloves, etc.) before entering the washroom.

If a washroom is located immediately off the production/harvesting/ packaging area, in addition to the self-closing doors and clothing hangers noted above, entrance/exit equipment (e.g., foot bath) and personnel supplies (e.g., hair nets, gloves, beard covers, etc.) should be provided.

A lockable locker or secure location should be provided for each employee. This will provide a safe place for personal belongings (e.g., jewelry) and discourage its presence in production areas. Lockers should be constructed of non-porous, cleanable material. They should be equipped with door vents to facilitate air flow into the locker. Locker tops should be sloped at 60° to prevent dust collection and use as a storage area.

Change rooms should also be cleaned daily. Lined garbage containers should be emptied daily and cleaned, if necessary. Soiled laundry should be collected in clearly marked, closed containers and removed regularly for cleaning.

Provisions should be made to store employees' lunches in the lunchroom. A glass-door display-type refrigerator will store lunches safely, deter theft and discourage pests. Employee food should never be stored in lockers. Lined garbage containers, especially those containing discarded food, should be emptied and cleaned regularly.

## E3 ESTABLISHMENT INTERIOR

### E3.1 Internal Structures and Fittings

**To prevent or minimize sprout contamination, you should meet these requirements:**

- Internal rooms, structures and fittings are suitable and are maintained for the operations taking *place within.*
- Floor, ceilings, overheads, doors, windows, stairs and other structures are cleanable, properly maintained, exhibit no evidence of degradation that would cause contamination and are suitable for the activities in each area.
- The condition of internal rooms, structure and fittings protects the safety and suitability of food.

**This is how to meet these requirements:**

A poorly designed facility may be difficult or impossible to keep clean. Attention to sanitation requirements during the design process can save time and resources and prevent problems later. Good design will also enhance production efficiencies.

The design and construction of all facilities must conform to local building regulations. Information about the Ontario Building Code, the latest Code developments, and advice on interpreting Code requirements may be found at: www.obc.mah.gov.on.ca/scripts/index_.asp.

**Floors** Floors should be waterproof, non-absorbent, washable, non-toxic, easy to clean and sanitize, and durable for their intended use (e.g., some environments may be wet and corrosive while others may alternate between hot and cold). Floor surfaces should be textured enough to prevent slipping but smooth enough to allow for thorough cleaning. If floor coatings or tile are used, they should be inspected regularly for cracks and crevices and/or other damage. Cracks and crevices can create an environment (e.g., trap moisture and debris) suitable for microbial growth. Any grout lines on tile should be properly sealed. If floor mats are used, they should be readily removable and be constructed of easily cleaned material.

To prevent water pooling and potential microbial growth, floors should be smooth and have a continuous slope toward trapped drains. A 1–2 per cent slope is suggested. Areas that do not drain well will need to be mopped or squeegeed regularly to minimize pooling and the potential for cross-contamination. Because floor drains can sometimes harbour pathogenic microbes (e.g., *Listeria),* drain covers should be easily removable to facilitate regular cleaning and sanitizing.

For additional information about *a Listeria*, visit the CFIA Web site for the following fact sheet:

- Listeria Food Safety Facts at: www.inspection.gc.ca/english/fssa/concen/cause/listeriae.shtml

**Walls and Ceiling**

All internal surfaces, structures and fittings should be constructed of non-absorbent, non-toxic, smooth, corrosion-resistant materials that are able to withstand repeated cleaning. As a minimum, walls should be smooth, waterproof, and easy to clean to a height appropriate for the operation. Light-coloured walls and ceilings are most easily monitored for the presence of soil.

Growth of microorganisms or moulds may result if walls and ceilings cannot be effectively cleaned. Materials that are not durable or suitable can deteriorate, resulting in physical contamination of food by flaking, peeling or rusting. The use of materials that cannot be adequately cleaned and disinfected should be avoided. The use of wood, even when a smooth, impervious material covers it, is not recommended. A list of acceptable materials may be found in the *Reference Listing of Accepted Construction Materials, Packaging Materials and Non-Food Chemical Products* published by the Canadian Food Inspection Agency. It may be accessed at: www.inspection.gc.ca/english/fssa/reference/refere.shtml.
Structural seams, cracks, crevices and any holes in walls and ceilings should be sealed to prevent entry of insects and rodents and to inhibit debris collection and microbial contamination. The area where the wall meets the floor should be "coved" (rounded at a 2.5 cm radius or sloped at a 45–60° angle) to increase cleaning effectiveness. Installation of wall "bumpers" will lessen damage by forklifts, pallet jacks and other moving devices. Damage-caused holes can permit entry of pests and other contaminants. Bumpers and sloped curbs should be sloped at a 45–60° angle.

Production facilities should have solid ceilings that cover areas where dirt can accumulate (e.g., rafter chords), birds can roost, and pests (e.g., rats, raccoons, pigeons) can nest and/or travel. Physical debris and microbially contaminated feces can fall from overhead structures, platforms, ladders, stairs, chutes, overhead utility installations, piping, etc. Areas where dirt and debris accumulate should be cleaned regularly. Minimize walkways or ladders over product and packaging areas. If this is not possible, ladders and walkways should be equipped with kickplates at least 10 cm in height to protect exposed food, ingredients, food contact surfaces and packaging materials from contamination.

Pipelines, electrical conduit, air lines and ducting should be mounted away from the ceiling to allow for cleaning and should be insulated to eliminate condensation. Only smooth hanger rods should be used instead of angle iron or threaded rods that can collect dust and soil. As an alternative, these service lines can be structurally enclosed on the ceiling or in the attic.

Ceilings should be designed so they minimize condensation (e.g., insulated) and hard surfaced so they do not absorb moisture, which encourages mould growth. Ceilings should be constructed from materials that do not flake or peel and are easy to clean.

Any painted or coated surfaces should be inspected often for signs of chipping, peeling, flaking or other loose particles. Repairs should be made immediately to eliminate these physical hazards.

**Windows and Doors**

Minimize the number of windows and doors in the production and packing areas. Windows should be tight fitting to prevent entry of pests and airborne contaminants. Window sills and ledges should be sloped at 45–60º to lessen the accumulation of dust and dirt and to discourage their use as a shelf.
Windows that do not open should be sealed. Windows that open should be fitted with screens fine enough (22 mesh or finer is suggested) to not only prevent entrance of insects but also allow easily removal for cleaning. Windows (both interior and exterior) that view sprout processing areas should not be opened. Repair damaged windows and screens promptly.

When possible, windows should be constructed of unbreakable material. Where glass windows are installed, they should be protected against breakage to minimize the potential for contamination by broken glass.

Doors should have smooth, non-absorbent surfaces, be easy to clean and

sanitize, and be able to withstand normal use and cleaning. They should be wide enough to allow product and vehicles to pass through without contacting (and potentially damaging) the door frame. Installing floor-mounted door bumpers may be helpful to protect doors from physical damage. Exterior doors, cold storage room doors and production area doors should be self-closing. All doors should be tight fitting and may be equipped with brush seals to discourage pest entry. A mouse can gain entry through an opening the width of a pencil (6 mm).

**Dry Storage Areas**

Establishment interior requirements also apply to storage areas. Floors should be waterproof, non-absorbent, washable, non-toxic, easy to clean and disinfect, and properly drained. All internal walls, ceilings, structures and fittings should be constructed of non-absorbent, non-toxic, smooth, corrosion-resistant materials that are able to withstand repeated cleaning. Paint may be used in this non-production area only if it is the only practical solution for a smooth, easily cleanable surface. However, surfaces should be free of chipping, peeling, and flaking paint, or other loose particles.

Doors should be tight fitting and easy to clean and sanitize. Windows also should be tight fitting and protected against breakage if not constructed from unbreakable material. Lighting should be of the correct intensity (see Section E3.2) and be protected against breakage. Ventilation systems should be adequately screened and designed to remove excess heat and humidity without cross-contamination (see Section E3.4).

**Coolers**

Establishment interior requirements also apply to the interiors of coolers. Floors should be waterproof, non-absorbent, washable, non-toxic, easy to clean and disinfect, and properly drained. All internal walls, ceilings, structures and fittings should be constructed of non-absorbent, non-toxic, smooth, corrosion-resistant materials that are able to withstand repeated cleaning. Doors should be tight fitting and easy to clean and sanitize. Lighting should be of the correct intensity and shielded to prevent accidental breakage.

Cooler loading doors should be equipped with PVC curtains that overlap at least 13 mm to help maintain cooler/freezer temperature when the door is open. Because they drag across ingredients, food products and equipment as it moves in and out of the cooler, these curtains have the potential to cross-contaminate. For this reason, they should be cleaned and sanitized regularly.

Coolers should be free of condensation. However, in case of equipment failure or loss of power, condensation collection pans and/or drain pans should be located beneath refrigeration equipment, coils and pipes to protect food and/or food ingredients. Regular inspection and cleaning of these collection pans is required.

The key to cold chain management is frequent temperature measurement. Monitoring may be accomplished either manually or with an alarmed temperature tracking system. Thermometers should be calibrated regularly following the manufacturer's directions. A more detailed discussion on calibration may be found in section O4 Equipment Maintenance. Refrigeration equipment should be kept in good repair. Instead of one large unit, many operators use two smaller refrigeration units in order to maintain some degree of cooling in the event of the failure of one.

## E3.2 Lighting

**To prevent or minimize sprout contamination, you should meet these requirements[1]:**

- The establishment has appropriate lighting to facilitate all activities including processing, inspection, cleaning and sanitizing, and maintenance.
- Lighting is of a design and type that does not contribute to a misleading assessment of food.

**This is how to meet these requirements:**

In sprout harvesting and packaging areas, the quality of light is important. Natural light is best to determine true colour, but is often impractical. Most fluorescent and incandescent light bulbs generate only a portion of the full light spectrum. This results in a misleading evaluation of colour. In areas where true food evaluation is required, full-light-spectrum bulbs should be used.

Lux is the metric measurement unit for light intensity. One lux equals the total intensity of light that falls on a 1 sq. m surface that is 1 m away from a one-candle-power light source. In the Imperial system, one foot candle equals the total intensity of light that falls upon a 1 sq. ft surface that is placed one foot away from a point source of light that equals one candle power. Since there are 10.76 sq. ft per sq. m, there are 10.76 lux per foot candle.

It is recommended that lighting intensity should not be less than:

- 540 lux (50 foot candles) in harvesting and packaging areas
- 220 lux (20 foot candles) in work areas
- 110 lux (10 foot candles) in storage and other areas including change rooms and washrooms.

Check light intensity when changes to the lighting system are made.

## E3.3 Lighting Fixtures

**To prevent or minimize sprout contamination, you should meet this requirement:**

- Light bulbs and fixtures in areas of exposed food, ingredients, packaging materials or food contact surfaces are equipped with shatterproof bulbs or breakage shields to prevent or minimize contamination of food if breakage occurs.

**This is how to meet the requirement:**

Lighting fixtures should be securely suspended or fastened to the ceiling so they cannot fall onto food, production lines or people.

Light bulbs and fixtures over food, ingredients, packaging materials, and food contact surfaces should be equipped with shatterproof bulbs or be protected with an unbreakable shield to trap fragments in the event of bulb breakage. Bulbs should also be protected against accidental breakage.

All fixtures and bulbs should be easy to clean. Regular cleaning will ensure that they do not contribute to contaminants falling onto seed, sprouts, packaging materials and food contact surfaces. Cleaning will also maintain light quantity and quality.

The cleanliness of lights should be monitored during regular premise inspection.

## E3.4 Air Quality and Ventilation

**To prevent or minimize sprout contamination, you should meet these requirements:**

- The establishment has and uses ventilation to keep rooms free of excessive heat, humidity, steam, vapours, smoke, particulates and condensation.
- Ventilation openings have screens or filters that can be easily cleaned or changed.
- Ventilation systems do not permit air to flow from contaminated areas to clean areas.

**This is how to meet these requirements:**

The volume of air exchange should be adequate to prevent excessive heat, steam, vapours, smoke, condensation and dust; to discourage the growth of mould and mildew; and to remove contaminated air. A mechanical system should be used; natural ventilation is not a realistic option in a sprout production facility.

Air intakes should not be located in areas where they may take in contaminated air. Intakes, including those for air compressors, should be equipped with tight-fitting screens and filters. Very fine filters (e.g., 0.1 microns) will remove airborne bacteria, yeast, mould and some viruses. Screens and filters should be easy to remove for cleaning or replacement and should be serviced regularly.

Fans, air ducts and other ventilation equipment should be kept clean and well maintained. It is a good practice to test interior air regularly for biological contaminants.

Pneumatic equipment systems (e.g., air compressors) should be fitted with an air dryer(s) to remove water and an air filter(s) to remove water, oil, oil vapour, dust and other contaminants. Filters should be monitored/cleaned regularly. As with facility air, air in the pneumatic system should also be tested regularly for contaminants.

In microbially sensitive areas (e.g., sprout harvesting, packaging areas), a positive air pressure system should be used (outdoor air is drawn in and the increased pressure forces stale, potentially contaminated indoor air out of the room). Positive air pressure should be highest in the packaging area and progressively lower back through to the receiving area. In this scenario, the direction of airflow is always from a microbially "clean" area (e.g., packaging) to a "dirtier" area (e.g., receiving).

## E3.5 Drainage and Sewage Systems

**To prevent or minimize sprout contamination, you should meet these requirements:**

- The establishment has and uses drainage and liquid disposal systems that are maintained to protect the safety and suitability of food and potable water supply.
- Drainage and liquid disposal systems are equipped with back-flow preventers and no cross-connections exist with drainage or waste systems and potable water lines.
- Pooling of water and liquids is prevented or addressed.

**This is how to meet these requirements:**

There should be an adequate number of floor drains to effectively drain liquids. A suggested guideline is one floor drain per 40 sq. m of floor area. The minimum recommended drain cover size is 30 $cm^2$. Drains can harbour *Listeria* and other pathogens, so drain covers should be easily removable to allow regular cleaning and sanitizing. For addition information about *Listeria* see the Canadian Food Inspection Agencies (CFIA) Web site for Listeria Food Safety Facts at: www.inspection.gc.ca/english/fssa/concen/cause/listeriae.shtml.

Floors should be adequately sloped toward the drains. A uniform floor slope of 1 to 2 per cent (2–4 cm per m) toward the drain is suggested. Always check with your local municipal building department before beginning new construction or undertaking renovations.

All drains should be trapped, vented and of adequate size to carry peak drainage loads. A minimum diameter of 10 cm is recommended. Where trench drains are used, they should flow from "cleaner" to "dirtier" areas.

Potable and non-potable water (e.g., effluent) systems should also be completely independent of each other and of sewage systems.

Potable water pipes should be clearly identified (e.g., colour coded) to avoid confusion with those carrying wastewater and sewage. Water systems should be equipped with back-flow prevention devices to prevent potential siphoning of contaminated liquids into the potable water supply (e.g., by hoses left lying on the floor).

Waste disposal systems should be constructed of corrosion-resistant material and be well maintained. Design should be such that there is no risk of cross-contamination of the potable water supply. The sewer system should not be interconnected with the food production drainage (effluent)

system in order to reduce the potential for cross-contamination in the event of a malfunction (e.g., sewage backup into production areas). Your location (municipal or rural), whether you are already connected to the sewer line, and your discharge rate per day will determine if the sewer and effluent lines should be separate. Consult your local Ministry of the Environment district officer or municipal building official.

Effluent or sewage lines should not pass over or through production areas where leaks could contaminate the seed, sprouts, packaging materials and food contact surfaces. However, if they should pass over or through production areas, covering these lines or placing a catch-trough below is not recommended. Such devices serve only to camouflage leakage problems that require immediate attention. In the event of a backup of wastewater or sewage, the affected areas should be thoroughly cleaned and sanitized before production resumes and contaminated food products, ingredients and packaging materials all discarded.

In contrast to effluent or sewage lines, overhead water lines that may create condensation should be wrapped with insulation and covered with a plastic sleeve.

Equipment drain lines should not discharge into work or traffic areas or into areas that are difficult to clean.

All drainage and sewage discharges must meet local building code regulations.

# E4 EQUIPMENT

## E4.1 Equipment Design, Construction and Installation

**To prevent or minimize sprout contamination you should meet these requirements:**

- Equipment and utensils that may impact on food safety are constructed of non-toxic materials, exhibit no signs of degradation that could contaminate food, and are easy to clean, sanitize and maintain.
- Equipment design, location, construction and installation promote effective assessment, maintenance, and cleaning and sanitizing activities.
- Adequate equipment or facilities are available for the activities conducted to protect the safety and suitability of food.
- Equipment functions in accordance with its intended use.

**This is how to meet these requirements:**

Equipment should be designed, constructed and installed so that it performs its intended function; is accessible for cleaning, sanitizing, maintenance and inspection; and minimizes the potential for biological, chemical, and physical contamination during operations. This applies to all holding, conveying, processing, and packaging equipment and utensils.

Design deficiencies (e.g., microbial growth niches) should be operationally managed. The fewer the number of design deficiencies, the lower the number of corrective people-dependent procedures required during operations.

All food contact surfaces should be non-toxic, non-reactive and non-contaminating to the food. Surfaces should also be non-absorbent, smooth, corrosion resistant, easily cleanable and able to withstand repeated cleaning without deterioration for the lifetime of the equipment. To avoid creation of corroded or pitted areas where microbes can hide and survive, equipment should be constructed of materials that are compatible with the product being produced, cleaning and sanitizing chemicals being used, and procedures used during cleaning and sanitation.

In most instances, this means that food contact surfaces should be constructed of stainless steel (300 series). The two main grades of stainless steel used in the food industry are 304 and 316. Grade 316 has virtually the same mechanical, physical and fabrication characteristics as 304 with better corrosion resistance, particularly to pitting corrosion in chloride

environments. If an application requires greater corrosion resistance than grade 304 can provide, grade 316 is the best choice. Generally speaking, 304 grade is used for product contact of dry components and 316 is used where liquid contact is involved. Food-grade plastic can also be used as a food contact surface. Avoid using wood and other similar materials that cannot be adequately cleaned and sanitized. The use of soft metals for surfaces subject to corrosion, and painted surfaces are not recommended. A list of acceptable materials, coatings and paints published by the CFIA may be found in the *Reference Listing of Accepted Construction Materials, Packaging Materials and Non-Food Chemical Products* at: www.inspection.gc.ca/english/fssa/reference/refere.shtml.

Equipment should have a simple, open design that permits ready access for inspection, maintenance, cleaning and sanitation. All enclosed equipment should have an adequate number of inspection and cleanout doors. For ease of accessibility, equipment components should be easy to dismantle without specialized tools. Equipment design should also minimize opportunities for product and moisture accumulation and eliminate points where microbes can enter, grow and reproduce.

An article outlining 10 principles of sanitary equipment design developed by the American Meat Institute (AMI) may be accessed at: www.foodsafetymagazine.com/issues/0306/colclean0306.htm. Although the article applies specifically to meat facilities, among buyers there are rising expectations for the same equipment design standards in sprouting facilities.

**Connections**

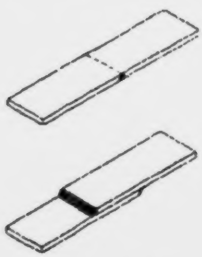
The use of rivets, bolts, studs or tack welds to attach mounting plates, brackets, junction boxes, nameplates and end caps creates an entry point for water and harbourage for microorganisms. Whenever possible, continuous welds should be used instead of fasteners.

Inspection doors and control devices such as push buttons, switches and valve handles should be designed, constructed and installed in such a way that they do not allow penetration or accumulation of food materials or moisture, which encourages microbial growth. The same stipulations apply to electrical control panels, junction boxes, chain and belt guards, etc. Each enclosure should be sloped on top to prevent use as a storage and/or dust gathering area.

Connection joints and overlapping parts provide excellent places for contaminants to hide and do not allow adequate room for cleaning water to force out microbe-harbouring food particles. Where technically unavoidable, fasteners should be cleanable with no exposed screw threads or recesses. An illustration of fasteners (hygienic risk and acceptable) may be found in the 3-A Sanitary Standards, NSF/ANSI/3-A Standard for Food Processing Equipment 14159-1999, page B7.

**Drainage Holes** Accumulated water or other liquid can harbour microorganisms and create an environment for their growth. Cleaning and sanitation chemicals may also pool on equipment, causing a chemical contamination risk. To prevent this, equipment drain holes should be adequate in number and size and strategically located to allow easy, unobstructed liquid and product drainage.

**Surfaces**




Food contact surfaces of both equipment and utensils should be free of niches such as crevices, stress cracks, open or gaping seams, pitted surfaces, bolts, rivets, holes, protruding edges, roll-under edges, recesses and creases that can trap food residues and encourage microbial growth. For the same reason, there should be no dead ends or dead spaces. There should be no evidence of, or opportunity for, rust or mould.

Welds should be continuous, ground smooth and polished to the texture of adjoining surfaces. Surfaces should be butt-welded to reduce microbial hiding places often found when overlap welding is used. Do not use caulking as a substitute for continuous welds.

**Conveyer Belts** Frayed conveyor belts can be a source of physical and microbial contamination. Smooth, non-porous modular plastic or stainless steel belts do not fray and are easier to clean than flat belts. Hinges on modular belts should open wide enough around the sprockets to allow cleaning water access to all areas but be tight enough on the surface to prevent food particle accumulation.

**Working Space** Equipment should be installed with enough working space to permit inspection; facilitate ease of cleaning and sanitation either in place or disassembled, and allow maintenance and lubrication. To allow access for cleaning, equipment should be separated by 45–90 cm and should be installed at least 75 cm from walls, 20 cm above the floor and 45 cm below the ceiling.

**Motors and Drives**

Motors and drives should be mounted to the side or below food contact surfaces (30 cm below food level is generally suggested as a suitable distance). If motors can be mounted only above food, drip pans should be installed under the motor and/or drive to catch leaking lubricants. For these pans to be effective, they should be inspected and cleaned regularly.

Where possible, bearings should be self-lubricating and sealed. Where this is not possible, use food-grade lubricants. The CFIA's *Reference Listing of Accepted Construction Materials, Packaging Materials and Non-Food Chemical Products* provides a list of acceptable lubricants. It may be accessed at: www.inspection.gc.ca/english/fssa/reference/refere.shtml.

Faulty shaft seals on production equipment may allow product to leak outside the line, where microbial growth can occur. These microorganisms may then grow back to the product side of the seal. To prevent the passage of microorganisms, double seals with microbiocidal barrier liquids should be used. However, if these barriers are not replaced on a timely basis, they may also become a growth medium for microorganisms. Worn and/or cracked gaskets are also excellent sites for microbial harbourage and contamination.

Motors should be fully enclosed, splash proof, explosion proof, and sealed to prevent contamination by moisture, dust and pests, and to lessen the risk of food contamination and personal injury to employees. Drives, pulleys and other rotating parts should be covered for the same reasons. Whenever possible, direct-drive motors should be used instead of chain-driven gearbox combinations. Splash and safety guards should be easily removable for cleaning. All moving parts should be designed to be easily repaired or replaced with minimal disruption to production and low contamination risk to product in the event of mechanical failure.

**Support Structures**

To avoid collection of dust, horizontal equipment structural supports should be constructed of round tubing or set diagonally if square tubing or angle iron is used. Upright floor supports should be free of floor flanges where microbes can hide and grow in residue accumulation.

Framework should be constructed so that moisture and soils cannot penetrate. Hollow areas (e.g., frames, rollers, etc.) that cannot be eliminated should be permanently sealed.

**Controls**

Pipe valves, equipment "kill" switches and operating controls should be easily accessible and easy to operate should there be a leak or mechanical malfunction. Quick stoppage will result in less contamination and less product loss. All enclosed equipment should have an adequate number of inspection and cleanout doors.

Wall-mounted switch boxes, electrical conduit, sinks, pipes, etc. should be mounted away from the wall for ease of cleaning (a minimum of 2.5 cm is suggested). Where direct wall mounting is unavoidable, caulking may be used to prevent microbial and/or soil niches. Ceiling-mounted devices (such as refrigeration units) should be installed tight to the ceiling so no difficult top-of-unit cleaning is required.

**Refrigeration Units**

Refrigeration units should be sized to cool product quickly and to maintain constant and correct temperatures for their particular application. All refrigerated areas should be equipped with temperature measurement and/or temperature recording devices. Installation of equipment-failure alarm systems should be considered, as well.

Evaporator drip pans in refrigerated rooms should be equipped with drain lines to remove condensate. Evaporator units (pans, fans, etc) should be inspected regularly for dirt and mould formation and cleaned as required. Refrigeration and drainage lines should be constructed of corrosion-resistant materials (e.g., stainless steel or copper) to prevent physical contamination of loose material falling into ingredients or finished product. Pipe insulation should be kept in good repair for the same reason.

**Compressors**

Air compressor units should be oil free to prevent cross-contamination of an oil odour and/or taste in food products. Potentially contaminating moisture may be removed with air dryers and/or traps. Traps and air filters should be cleaned and/or replaced regularly. Along with sampling room air, producers may also sample compressed air for contaminants including yeast and moulds.

**Containers**

Containers, vehicles and other equipment used in the facility to transport seeds, packaging materials and finished product should be kept clean and well maintained to reduce the potential for cross-contamination. To accomplish this, separate wash areas/rooms should be provided for cleaning seed containers and equipment, and for cleaning sprout growing trays, containers and equipment.

**Utensils**

No wooden-handled utensils (e.g., brooms, brushes or squeegees) should be used in a sprout production facility. All should be constructed from food-grade materials to facilitate effective cleaning and minimize potential physical (wood splinters) contamination.

Clean-out-of-place (COP) tanks should be provided for cleaning small equipment parts and utensils. Clean utensils, small tools and protective apparel (e.g., aprons) used during sprout processing activities should be stored on non-toxic, non-reactive, non-absorbent, smooth, corrosion-resistant surfaces, shelving, hooks or racks (e.g., stainless steel or food-grade plastic).

Equipment, utensils, brushes and containers used for cleaning and sanitizing should be colour coded or labelled to identify their intended use and the area to which their use is restricted. All cleaning and sanitizing devices should be constructed of easily cleanable, non-absorbent (some natural fibres used in brushes can absorb, and later release, bacteria and viruses), non-toxic material. Following use, cleaning equipment should be stored grouped according to its intended use, separated from cleaning equipment with other intended uses, and away from sprout processing areas.

**Tools**

Tools should be constructed from materials that are resistant to cracks and scratches (where microorganisms can grow) and are easy to clean. A documented system (e.g., a Standard Operating Practice or SOP) should be in place to describe how tools should be cleaned, who is responsible for cleaning them, how often they should be cleaned, and how and where they should be stored. Tools should be well maintained but replaced as soon as they become worn or are in poor condition.

**Detection Devices**

To ensure protection of sprouts, installation of screens, magnets, metal detectors or other equipment is often necessary. Each should be located where it can provide maximum protection during processing. For example, the greatest benefit from a metal detector is achieved when it is positioned to check product that is already inside its final packaging. All protective equipment should be properly maintained and calibrated. A more detailed discussion on calibration may be found in section O4 Equipment Maintenance.

Process monitoring and control devices should be plentiful and easy to read and interpret.

## E4.2 Waste Containers and Utensils

**To prevent or minimize sprout contamination, you should meet these requirements:**

- Containers and utensils used for collection and holding of waste and inedible or hazardous substances are clearly identified, function properly, exhibit no signs of degradation that could lead to the contamination of food, and can be cleaned and maintained.
- Containers and utensils are cleaned prior to entering food processing, handling or storage areas.

**This is how to meet these requirements:**

Waste containers within the production facility used for collecting solid or inedible waste or hazardous material should be clearly identified for their intended use. If not clearly identified, there is risk of cross-contamination if food products are inadvertently placed in containers meant for non-food use. Colour coding can be an effective differentiation tool. Containers should be of adequate size for the amount of waste generated and be fully covered with easy-opening lids that prevent accidental spillage and entry of pests.

Waste containers should be leak-proof, waterproof and constructed of durable, easy-to-clean material. Leak-proof plastic or wet-strength liners may be used. Containers should be cleaned inside and out before being taken into sprout processing, handling or storage areas. Areas used for cleaning waste containers should be physically or operationally separated from production areas.

Waste should never move through sprout production, handling or storage areas when there is risk of contamination or cross-contamination with seeds, sprouts and packaging. It should never pass over sprout washing or packaging lines. To avoid cross-contamination with employees and equipment, care should be taken not to spill waste while emptying containers.

## E4.3 Hand-washing Stations

**To prevent or minimize sprout contamination, you should meet these requirements:**

- An adequate number of conveniently located and readily accessible handwashing stations are provided in areas where exposed food, ingredients and packaging materials are processed or handled, and in washrooms and other locations necessary to prevent or minimize contamination.
- Handwashing stations are properly installed and maintained and are provided with warm potable water, soap, a hygienic drying apparatus and a cleanable waste receptacle.

**This is how to meet these requirements:**

During production activities, employees' hands often become soiled. In addition to employee washrooms, the production area should be equipped with handwashing stations. Every facility should have a sufficient number of handwashing stations to allow employees to wash their hands without waiting. The number of stations will depend on the size of the production area and the number of employees. As a starting point, one handwashing station should be provided for every 75 sq. m of food production area.

Each station should be equipped with potable warm water, liquid soap in a pump dispenser, disposable paper towels and cleanable waste container. Paper towel dispensers should allow the paper towel to be pulled out without the freshly washed hands touching the dispenser. A hand sanitizer may also be provided. Ideally, tap operation should be "hands free" to prevent recontamination of hands. Refer to picture below. These facilities should be easily accessible, and access to them should not require travel through another processing area.

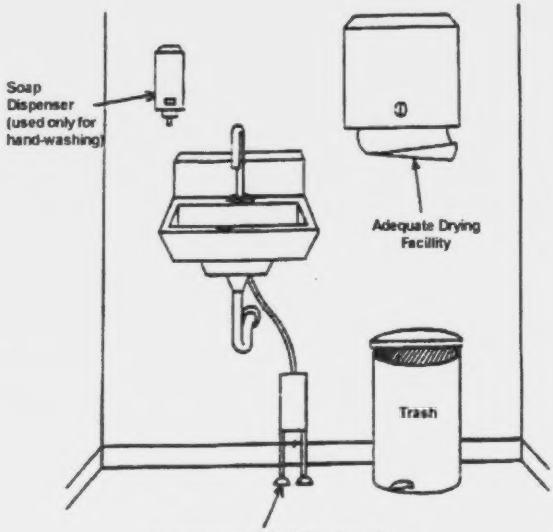
Handwashing stations should be kept clean so they do not become a source of contamination. They should never be used for purposes other than handwashing (e.g., washing utensils). Each should be equipped with a trapped drain.

Signs in appropriate languages should be installed to remind employees to wash their hands before they begin work, after each absence from their workstation, and any other time that their hands become soiled.

While it may sound simplistic, employees should be trained to wash their hands correctly. Section O1.2 discusses proper handwashing techniques in detail.

In some production facilities, foot-sanitizing baths or foamers may be installed at entrances to production areas. Sanitizing solutions should be changed often in order to retain an effective sanitizing level.

Source: Food and Drug Administration, *Food Establishment Plan Review Guide*. 2000 Section III, Part 4, p. 47.




Handwash Sink Example

## E5 WATER SUPPLY

### E5.1 Adequate Supply and Protection of Water, Ice and Steam

**To prevent or minimize sprout contamination, you should meet these requirements:**

- Potable water, ice and steam are supplied at volumes, pressures and temperatures necessary for all sanitation and operational activities.
- Appropriate facilities for water storage, treatment, distribution and temperature control are available to protect the safety and suitability of food.

**This is how to meet these requirements:**

**Potable Water** Potable water should be supplied at volumes, pressures and temperatures necessary for operational and cleaning and sanitation procedures. As noted earlier, potable water systems should be separate from non-potable water (e.g., wastewater, and auxiliary lines such as sprinkler systems and sewage lines) and should be clearly identified (e.g., by colour coding or labelling).

All hoses and taps supplying potable water should be equipped with back-flow devices. When used as an extension of a water outlet, hoses and taps have the potential to siphon contaminated water back into the potable water supply if there is sufficient pressure difference.

For example: A garden hose is left running on the floor. A floor drain backs up so there is effluent on the floor. Just then, a large capacity water pipe in another section of the facility is turned on, significantly lowering pressure throughout the system and drawing water toward the large capacity pipe. As a result, effluent is siphoned into the water system through the hose lying on the floor, contaminating the water system. The contaminated water is sprayed on the sprouts.

To prevent this reverse flow (back-flow), back-flow devices (e.g., vacuum breakers or check valves) should be installed in **every** potable water outlet.

When not in use, hoses should be coiled neatly and stored so they do not impede floor drainage or trap waterborne contaminants. Storage should be on hangers where they will not contact ingredients, food contact surfaces, packaging materials or finished food products. Hoses should also be cleaned externally and internally (e.g., with a turbulent air/water mixture) on a regular schedule to remove dirt and microbial contaminants.

**Recycled/Recirculated Water**

Recycled/recirculated water is **not** recommended for use as sprout production irrigation water.

**Potable Water Transportation and Storage Containers**

Water/ice transportation and storage containers should be constructed of food-grade materials. Both should meet construction criteria outlined in the CFIA's *Reference Listing of Accepted Construction Materials, Packaging Materials and Non-Food Chemical Products*, which may be accessed at: www.inspection.gc.ca/english/fssa/reference/refere.shtml.

## E6 SECURITY (section E11 in *HACCP Advantage Plus+*)

### E6.1 Facility Security

**To prevent or minimize sprout contamination, you should meet these requirements[1]:**

- The facility is adequately secured and provides effective means to discourage unauthorized entry onto facility property.
- All access points into the facility are secured by guards, alarms, cameras or other security measures.

**This is how to meet these requirements:**

When developing physical security measures for a facility the main objective is to be able to see what is going on in and around the facility. Keep in mind that criminals do not want to be seen.

**Alarms**

Burglar alarms can be a very useful physical security measure. There are two types of detection systems:

- Perimeter detection systems
- Space detection systems.

Perimeter detection systems protect exterior doors and windows with magnetic contacts. Space detection systems are triggered by sound, heat or motion and are most useful in large open areas like production areas or warehouses.

Burglar alarms may be considered for sensitive areas such as offices, records storage, high asset storage rooms (computers, laboratory equipment, labels, etc.), maintenance shops, etc.

Before installing an alarm system that automatically alerts the police, consider the disadvantage of false alarms. Many law enforcement centres charge a fee for false alarms or will not respond after a certain number of false alarms. It may be more beneficial for the facility to have an alarm system that alerts the facility itself instead of the police. For example, if an exterior door was left opened, the alarm would alert the main office or security co-ordinator.

**Cameras**

Cameras or closed-circuit television (CCTV) systems are useful to prevent inappropriate or illegal activity and to have a recorded history of the event, as long as they are properly positioned and monitored. Facilities need to decide whether to use real-time monitoring (an employee monitors the system at all times) or monitoring for historical purposes. Consider the facility's location as well as past events.

Qualified camera installers should be consulted for proper positioning. Cameras mounted too high will capture only the top of the criminal's head, making him or her extremely difficult to identify. Cameras mounted too low are susceptible to vandalism. Lower mounted cameras should have vandal-resistant lenses or housings. CCTV may require environmentally controlled housing to minimize frost or ice on the cameras.

CCTV systems can be leased or purchased. The benefits of leasing the equipment include camera systems upgrades as new technology is introduced and perhaps maintenance benefits. Cameras and equipment are expensive to buy and maintain. The facility should carefully consider if CCTV is the correct security measure or if other measures may provide better security.

**Locks**

Locks are used throughout the facility to control access to various entry points. Key control is one of the most important elements in order for locks to be effective. Keys are available in a wide variety, including mechanical keys, number code access pads, electronic swipe cards or biometric identifiers (hand, fingertip, retinal).

Food facilities have used keys for access for many years. Some people consider keys an effective means of access control, while others say keys are outdated and not cost effective. It is recommended that keys have the words "Do Not Duplicate" on them. This may prevent employees from duplicating their keys at a hardware store.

Specific questions should be answered when developing a key control program:

- Who is authorized to issue keys?
- Who is responsible for key duplication?
- What is the facility's policy for loaning keys?
- Do employees sign a form when keys are issued to them?
- Where are the keys stored?
- How are the keys to a specific lock or door identified?

- How often do you audit your key program, and when was the last time?
- What is your company policy when not every single key is accounted for?

Key control is necessary for not only employees, but also vendors, contractors, etc.

Locks may be used for many entry points throughout the facility and should be tested periodically to ensure they are functioning as designed. Security audits determine the level of compliance to the key control security program.

One of the most common failures during a security audit is that unauthorized individuals have gained access to keys, or locks have been overridden. Some common lock and key control failures include:

- Employees share access codes.
- Employees duplicate mechanical keys.
- Locking mechanisms are not used on overhead doors in shipping or receiving.
- A wad of tape is stuffed in the doorframe, preventing the latch bolt from engaging properly.
- Rocks or other items are placed in the door frame to prop a door open.

Many different types of locks can be used for facility doors. The level of security required for each access point will typically determine what type of lock is required. Consult a security adviser or locksmith for the proper application and type of lock.

**Fences**

Before building any fence, ensure it will meet local or city requirements. Not all facilities need fences; however, some facilities may benefit from the protection they provide. Before installing a fence consider:

- Location
- Height
- Type
- Proper installation.

It is critical to be able to see what is inside and outside the fenced area. Install the security fence at least 1 m to 1.5 m inside the facility property line. This allows for appropriate maintenance of trees, shrubs and undergrowth outside the fence. This also allows the facility, instead of

neighbours, to control what is stored directly against the fence. If shrubs, plants or trees are to be planted near the fence, remember that they will limit visibility and require maintenance.

Determine the purpose of the fence before selecting a material and height. In order to minimize access, fences should be at least 2 m above the finished grade. In certain areas, a 2.5 m to 3 m fence may be required. In a low-risk security environment, shorter fences may be installed if the only purpose is to mark the property boundaries. Keep in mind that shorter fences provide little protection for access control.

A fence used for security purposes should be constructed of 6.3 cm 9-gauge galvanized mesh (chain link) to allow viewing. Security fences constructed of wood may be more eye appealing, but you cannot see through them. If maximum protection is required, use a three-strand barbed wire top guard or razor ribbon wire.

When installing the fence, bury the bottom part of the fence and ensure the fence follows the contour of the property. Burying the fence underground makes access more difficult for digging animals, and the fence is more secure.

Protect the grounds and facility as much as possible. Determine what requires protection, and fence only that to reduce the amount of fencing needed. The facility exterior walls may also be used in place of a security fence.

The fence should be maintained and inspected for damage in the fencing material and the surrounding area. Vehicles or forklifts may cause damage to the fence. Consider placing barriers, such as concrete bumper blocks, around certain locations to prevent damage to the fence. Repair or replace any damaged area as quickly as possible. Monitor plant, tree and shrub growth and prune foliage as required to maintain visibility.

**Gates**

Gates should match the fence in strength and texture. Hinged gates or sliding gates can be used. Ensure gates close properly and do not allow people to slip between the gate and the fence posts.

There are several ways to open gates (e.g., having a guard open and close it, or using technological systems such as electronic access or audio-visual identifier [AVI]). Hiring a guard to operate the gate and monitor individuals and vehicles entering the facility property is the most secure

method, but costly. Automatic gate openers work well and are less expensive. The automatic gate opener should close and relock automatically. If it stays open for a long period of time, it may allow unauthorized entry. If sliding gates are purchased, keep them clear of snow and ice buildup during winter months.

**Signs**

Signs provide information to employees and outsiders so they are aware of security measures in the facility. For example a "No trespassing" sign on a fence prevents outsiders from entering the facility grounds and a "Restricted-access" sign on the laboratory door prevents unauthorized employees from entering the lab.

Signs are a cheap, valuable form of security protection. It is important that signs are visible from the time a visitor enters company property to the time he or she leaves.

Signage needed at most facilities include those indicating:

- Visitor parking
- Visitor entrance and sign-in
- Visitor waiting areas
- Employee parking
- Employee entrance
- Employee break rooms
- Restrooms
- Shipping and receiving truck routes
- Restricted-access zones or offices
- Emergency exits
- No trespassing.

Your facility may have to install signs in several languages if the employees or visitors in the area cannot understand English.

**Exterior Lighting**

A well-lit facility exterior prevents criminals from attempting to access the facility and also increases the ability to detect suspicious activity. To prevent tampering, exterior lights should be placed higher than 3 m. If the lights should be located lower than that, they should have vandal-resistant lenses because criminals often break lights to work in darkness.

Ensure that metal halide lamps are positioned away from any doorways or other areas because they attract flying insects, which may then enter the facility. Mount the lights on light standards away from the building and shine them on the facility or desired areas.

For security purposes, it is recommended that photoelectric cells, not switches or timers, control exterior lights. Photoelectric cells are operated by changes in darkness and ensure lights are operating from dusk to dawn. Switches or timers may not operate when necessary, specifically during daylight savings time and when days become longer or shorter through the seasons.

**Guard Services**

When facilities are large or located on a large lot, a guard service may be used as a physical security measure. Facility management should review guard services to determine if they are needed.

The most common guard service used at facilities is guards stationed at a guard post. The guard post is usually located at the gated facility entrance, and the guards monitor everyone coming and going. The guard is also responsible for opening and closing gates to allow entrance to company property.

The benefits of using gate guards include:

- Assessment of visitors before they gain access to facility property
- Preventing two or more cars entering a gate while the gate is open (tailgating)
- Initial inspection of trucks entering the facility
- Verification that trucks are actually scheduled to be at the facility.

When possible, gate guards and their guard post (building) should be located outside the gate to improve control over who enters company property. If guards are placed inside the gate, it is more difficult to prevent an unauthorized person from advancing onto facility property, as he or she is already inside the fenced area during the guard's inspection.

Guards can also carry out random inspections of:

- Doors and perimeter fencing to ensure they are properly maintained and secured
- Exterior doors to ensure they are secure.

Guards should document results, action taken, and dates and times of these inspections.

**Employee Parking**

In terms of providing security for employee parking, ask the following questions:

- Is it possible to locate the parking area near guards?
- Is the parking area secure? If not, can the facility provide a fence or other security measure?
- Is there enough lighting? Employees feel safer with more lighting and criminals are discouraged from entering well-lit parking areas. Remember that most criminals do not like to be seen while committing their acts.
- Is it practical to install security cameras in parking areas? This is costly, but provides additional security benefits.

**Doors**

Exterior doors play a critical role in facility security. In most cases, exterior doors are a last line of defence. If an intruder makes it through the exterior door, he or she has access to the facility, products and employees. Therefore, it is important to ensure any security program incorporates exterior doors.

There are two major components of entryways: the door and the lock. If either of these parts is not as strong as the other, security will fail.

Security levels increase when fewer doors are at the facility. Most facilities need only three exterior door entry points: one for visitors, one for employees, and one for shipping and receiving. If your facility currently has more than three exterior doors and wishes to reduce the amount of entrances, simply remove door hardware located on the exterior.

**Remember that the interior hardware on doors required to be emergency exits should remain in place. Consult local safety codes to ensure required doors or hardware are not removed.**

The door itself should be Grade 3 steel or aluminium. The door frame should match the door in terms of material. In other words, do not hang a steel door on a wooden frame.

Doors should be equipped with an automatic closing device to ensure the door closes and latches after personnel enter or exit. During security audits, check the function of the door. Interior and exterior doors should be numbered on both sides to allow easy identification during preventive maintenance, inspections and emergency situations.

Secure outside windows with locks or sensors to prevent entry by unauthorized persons.

**Roof Openings**

During the facility security assessment, the facility security team should determine what materials and equipment are located on the roof. Intakes, exhausts and mechanical equipment are a few common items found on roofs at most facilities. For more information on the facility security team see Section O9.

Next, determine if the roof is easily accessible. Many facilities have outside ladders that lead to rooftops; others have interior access. Whichever is the case, give special consideration to roofs in regards to security.

There are several ways to secure a roof. First, look at your ladders. Some may be removed and others can be secured. If possible, store ladders inside the facility or another locked building. Ladders located outside require extra security. If ladders are not a security concern, look for other ways a person might gain access to the roof. Downspouts, equipment located near the plant, silos and antennae are all possible access points and should be closely examined.

**Facility Water**

Facility water resources should be protected. Water is an important ingredient applied to or used in sprout production. Water is also used every day in facilities for sanitation and handwashing. Therefore, it should be considered an incoming ingredient, and protected as such. Facilities may use city/ township water or well water resources. Each requires a different type of protection.

City water is the main water source for most sprout processing facilities. Many facilities assume that the city security program protects the water resource. The facility should contact or visit the local water department to get more information about its security program. Ask about water quality checks and how often they are performed. Also find out how you will be notified if water resources are suspected or found to be contaminated.

Well water is a major concern that should be addressed by the facility security plan. Wellheads should be covered with some type of building and locked with restricted access. They should be located within the perimeter fence and should be inspected often for signs of tampering to the building, pipes or heads. Proper lighting should also be provided to deter aggressors and detect suspicious activity.

**Railcars/Trailers**

Work closely with raw material suppliers and trucking/rail companies to ensure that trailers are sealed and that seal numbers are documented on the bill of lading. Inform your suppliers that your plant has a security program and that it is against company policy to accept incoming deliveries that do not have proper seals. Improperly sealed loads will be rejected. The risk is simply too high to accept product if you cannot verify that it has come directly from your supplier and not been tampered with en route. Suppliers know how much a returned shipment costs and will usually comply.

Prepare written procedures to explain how seal checks will be conducted and what action will be taken when seals are not in place or seal numbers do not match. First, ensure that seals are intact and that numbers match the bill of lading. Do not let drivers break the seals and bring them to the receiving office for verification. Next, open the doors and take note of what is inside the carrier. If there are any unusual smells, cleaning issues, discrepancies in inventory counts, or any other suspicious circumstances, reject the shipment or at least investigate further. If the inventory count is incorrect and does not match the bill of lading or purchase order, inform the purchasing department.

The instructions for these inspections should be very detailed. All employees conducting these inspections should be trained to identify possible issues. Have clear, specific procedures in place to handle any issues identified during the inspection.

**Truck Drivers**

There is always activity occurring at the loading dock area. One of the biggest challenges in this area is controlling truck drivers. The most effective security measure is to provide a designated entrance for drivers that allow them to deliver the necessary paperwork and receive instructions for their shipment. This waiting area should be big enough for the number of drivers typically present and should include a telephone, vending machines and a restroom. Providing these amenities in the waiting area eliminates the need for drivers to enter other parts of the facility. The waiting area should be secure so that a driver cannot enter doors leading to

other areas of the facility.

The supplier or customer should provide you with the name of the driver and the specific truck/trailer he or she will be driving. It is good practice to require all drivers to present government-issued photo identification and a company-issued identification.

Some facilities may allow drivers on the dock area to watch while their vehicles are loaded/unloaded, to properly secure their cargo, or to verify quantities. In this case, provide additional security to monitor the drivers. You should also maintain a log to document all drivers who have entered (and left) the dock area. Company policies regarding GMPs, safety, security and other requirements should be posted in this area for drivers and staff to review.

Drivers should not be allowed to wander beyond the dock area into other parts of the facility. At a specified frequency monitor the dock area and the drivers' activities. If a person is not available to supervise, cameras can be used to deter inappropriate activity and to provide a recorded history of events in this area. Some facilities also issue drivers a colour-coded hard hat or hairnet so that facility personnel can easily identify them and monitor their activities.

**Additional security information may be accessed at the following links:**

USDA (U.S. Department of Agriculture)
*FSIS* (Food Safety and Inspection Service) *Security Guidelines for Food Processors.*
www.fsis.usda.gov/OA/topics/SecurityGuide.pdf

USDA FSIS
*Industry Self-Assessment Checklist for Food Security*
www.aamp.com/foodsafety/SelfAssessmentChecklistFoodSecurity.pdf.pdf

U.S. Food and Drug Administration
Guidance for Industry: *Food Producers, Processors, and Transporters: Food Security Preventive Measures Guidance*
www.cfsan.fda.gov/~dms/secguid6.html

*AIB Guide to Food Security* can be found at:
https://secure.aibonline.org/php/ecomm-catalog.php?catalogNbr=06-1460&site=0

# O1 PERSONNEL PRACTICES

## O1.1 Personal Hygiene/Practices

**To prevent or minimize sprout contamination, you should meet these requirements[1]:**

- All personnel follow personal practices that prevent or minimize contamination of food, ingredients, packaging materials and food contact surfaces.
- Personnel do not eat, use tobacco, drink, chew gum, spit, sneeze or cough over food or food contact surfaces, or perform any other potentially hazardous activities in areas where food or packaging materials are being processed, handled or stored.
- Objects, such as jewelry, that may cause contamination are removed or are suitably covered prior to starting work duties.
- Personnel maintain an appropriate degree of personal cleanliness.

**This is how to meet these requirements:**

People are the primary source or vector of contamination in sprout facilities. Contaminants can be transferred directly from the body, skin, mouth, hands, fingernails or hair to the food product during daily activities or can be transferred indirectly via food handlers' clothing, footware or the utensils (e.g., scoop) and equipment used.

Food handlers should maintain a high degree of personal cleanliness. The necessity of daily bathing and hair washing should be emphasized. Fingernails should be kept clean and trimmed. Reasonable amounts of deodorant or antiperspirants should be applied to protect against contamination by perspiration. However, the use of perfume or cologne should be avoided.

Use of skin and hair cosmetics (including false eyelashes, false fingernails, and fingernail polish) or other substances applied to the skin or hair (including medicines and other chemicals) that may contaminate sprouts, sprout contact surfaces, or sprout packaging materials should not be permitted. Personal grooming (e.g., brushing hair or application of cosmetics) should be forbidden in all production and ingredient handling areas.

[1] All "standards" statements in this guidebook reflect "What Is the Standard?" as described in the HACCP *Advantage Program Manual, Version 2.0.*

Those engaged in food handling activities should make every effort to avoid contamination of food. For example, there should be no eating; drinking; sneezing or coughing over unprotected food; spitting; taking medication; use of tobacco, chewing gum or candy; or engaging in other unhygienic activities near sprouts, sprout contact surfaces or sprout packaging materials. While they work, employees should also be encouraged to refrain from touching body surfaces including hair, nose, mouth, and other areas where microorganisms are abundant. Those who do so should wash their hands immediately.

Everyone entering food handling areas should remove jewelry including earrings, rings, watches, pins, badges and other unsecured jewelry, or any other objects that could fall into food, containers or equipment or otherwise contaminate food. Hand jewelery that cannot be removed, such as plain wedding bands and MedicAlerts, should be fully and securely covered with materials that can be maintained in an intact, clean and sanitary condition that prevents food contamination. No food or personal effects of any sort should be allowed into sprout production and packaging areas.

**SOP**

Each of these requirements that are appropriate to your operation should be included in a written Standard Operating Procedure (SOP). SOP preparation details are included in Section 7. As a condition of employment, every employee should be required to agree, in writing, to comply with these standards.

## O1.2 Hand Washing

**To prevent or minimize sprout contamination, you should meet these requirements:**

- To prevent or minimize food contamination, effective handwashing is performed by all personnel who enter the food processing and handling areas or who handle food, ingredients, packaging materials or food contact surfaces.
- Handwashing is performed with warm, potable water, soap and hygienic drying apparatus upon entering food processing and handling areas; prior to handling food, ingredients, packaging materials or food contact surfaces; following breaks or use of toilet facilities; and when hands become contaminated.

**This is how to meet these requirements:**

Handwashing is the single most effective method to reduce transmission of pathogens to food. Everyone who enters a food production facility should maintain hand hygiene to prevent microbial contamination of food products and food contact surfaces.

"Resident" and "transient" bacteria exist on the skin of normal, healthy people. Resident bacteria can be found in small folds of the skin, on hair and under fingernails. They are always there, cannot be completely removed and usually are not harmful. Transient bacteria are transferred to the skin by a variety of means during everyday activities (e.g., 10,000 microbes are transferred during a handshake). Transient microorganisms may be found on hands, fingertips and fingernails. Because they are loosely attached to the surface of the skin, they can easily contaminate food products or food handling surfaces if food handlers do not wash their hands adequately. (There are 10 billion microorganisms in one gram of feces; there are more bacteria in a gram of feces than the total number of people in the world .) Hands can also become contaminated with viruses that can be similarly transferred.

Almost all disease-causing microorganisms (bacteria, viruses, moulds, yeast and parasites) are transient. As few as 10 virulent microbes (e.g., *E.* coli O157::H7) may cause illness in vulnerable individuals (e.g., the very young, the old and those who are immuno-compromised). Pathogenic bacteria believed to be transmitted by food workers include *E. coli*, *Salmonella* spp., *Campylobacter, Shigella* spp., and *Clostridium perfringens*. Hepatitis A and noroviruses have also been identified as worker-transmitted causes of foodborne outbreaks.

Hand contamination may originate from a number of different sources. These include other hands and body surfaces, objects and environmental surfaces, clothes and fabrics, body secretions and excretions, equipment, water, food, soil and animals.

Hands should always be washed:

- Immediately before handling food (e.g., sprouts), ingredients (e.g., seed), packaging materials (e.g., seed bags, sprout containers), and/or touching food contact surfaces
- After using the toilet
- After coughing, sneezing, blowing or wiping the nose, or touching hair or the face
- After each absence from the work station for coffee breaks and eating
- After handling incompatible food products, raw materials, or potentially hazardous materials such as garbage or cleaning chemicals or touching non–food contact surfaces such as light or control switches
- After picking up objects off the floor
- Any other time hands become soiled or contaminated.

Studies show that hand hygiene consistently falls short of recommended standards. This may be due to an inadequate number of handwashing facilities, inconvenient/inaccessible location of handwashing facilities, insufficient time, lack of supplies (e.g., soap, towels), lack of adequate handwashing training or lack of supervision.

Proper handwashing technique may be summarized as follows:

- Remove hand jewelry. Millions of microorganisms can hide under rings, watches and bracelets.
- Roll up sleeves far enough so that wrists are exposed and sleeves do not get wet during washing.
- Wet hands and wrists under warm water (38ºC to 43ºC).
- Apply sufficient amount of soap. Plain detergent soaps physically remove soil and microbes. A list of acceptable hand cleaners/sanitizers may be found in the *Reference Listing of Accepted Construction Materials, Packaging Materials and Non-Food Chemical Products* at: www.inspection.gc.ca/english/fssa/reference/refere.shtml.

- Lather soap and scrub hands well, palm to palm. Scrub in between and around fingers. Scrub back of each hand with palm of other hand. Scrub fingertips of each hand in opposite palm. Scrub each hand clasped in opposite hand. Scrub each wrist clasped in opposite hand. Alternatively, use a fingernail brush to produce lather on fingertips, hands and arms. In either instance, scrubbing should last for a minimum of 15 seconds to loosen transient microorganisms. (Sing one verse of *Happy Birthday* to yourself, slowly.) There is no need to loosen resident microorganisms by scrubbing for a longer period.
- Rinse hands and wrists thoroughly under warm running water of sufficient volume (8 L/minute suggested) to wash off the pathogens that have been loosened by handwashing.
- Dry hands well with a single-use paper towel. Transfer of bacteria and viruses occurs less frequently when hands are dry.
- To avoid recontamination, turn off water tap using the paper towel (if taps are not hands free). Alcohol-based sanitizers or protective hand creams can be used after handwashing. The same scrubbing actions used during handwashing should be used to apply alcohol sanitizers. Keep rubbing until hands are dry. Alcohol sanitizers are immediately effective against bacteria but have limited residual activity. Non-alcohol based hand sanitizers are also available.

An illustration of proper handwashing techniques may be found at the end of this section or at:
www.health.gov.on.ca/english/public/pub/pubhealth/pdf/handwash_tech.pdf

**Fingernail Brush**

The U.S. Centers for Disease Control has documented that the bacterial population can be as high as 2 to 3 million *per fingernail*! These bacteria numbers can be reduced only by use of a nailbrush. Those that cannot be removed should be covered with gloves.

Some experts suggest that double handwashing is necessary before beginning the work day and immediately following use of the toilet. In this case, use of a nailbrush on fingertips and hand is followed by a thorough rinse then handwashing without a nail brush. While use of a fingernail brush is necessary to remove soil from under and around fingernails, excessive use should be avoided to prevent skin irritation. Irritated areas tend not to be washed as often or as effectively as necessary.

**Soap**

Plain soap is adequate for removing transient microorganisms from the hands of food handlers whose hands will be covered with gloves. Antimicrobial soaps may not only destroy too many beneficial resident microorganisms, but also dry skin excessively. Alcohol preparations also eliminate both resident and transient microorganisms but are not a substitute for handwashing with soap.

However, if gloves are not being worn (not a recommended practice), the population of microorganisms on hands should be lowered to as low a level as possible. This may be accomplished by using antimicrobial soaps and/or using an alcohol-based preparation after washing.

**Hand Drying**

The use of hot air dryers is generally not recommended. Dryers have been shown to increase levels of bacteria on hands because they accumulate and distribute toilet aerosols. Many handwashers do not have the patience to wait for their hands to be dried completely. As a result, clothing may be used as a towel. Damp hands are also conducive to microbial growth. (Studies show that 1,000 times as many germs spread from damp hands as from dry hands.)

Several studies have shown a significant reduction in bacterial counts when hands were dried with paper towels. The reduction was attributed to friction physically removing bacteria from hands. Used paper towels may also be used to shut off water taps in situations where foot pedal– or knee-operated taps are not available. Towels may also be used on door handles to avoid touching them with clean hands.

Where possible, paper towels should be provided from touchless dispensers. Do not use cloth towels, which can become a source of pathogen transfer to clean hands.

**Glove Use**

Wearing gloves during food handling is widely accepted as an effective method of preventing the transfer of microorganisms from food handlers to food. However, gloves are effective only if they are part of a larger hand sanitation regime.

Hands should be clean and sanitary before gloves are put on. As noted earlier in this section, hands can become contaminated by touching body surfaces, secretions, and excretions, or from touching a number of environmental surfaces. If contaminated hands are not washed before donning gloves, the outer glove surface becomes contaminated during the act of putting them on and the inner surface becomes contaminated by contact with the dirty hands. Once on, gloves can be further contaminated by poor worker hygiene practices in the same way that hands are.

Microbial growth on hands is accelerated inside gloves, especially if hands are wet. Gloves with defects, those that leak, and those that are ripped or otherwise compromised expose these microorganisms to food, food contact surfaces and packaging materials. Therefore, poor quality gloves, gloves that have lost their integrity and disposable gloves that are being reused may cause more contamination than they prevent.

Whenever an employee leaves his or her workstation, or after he or she sneezes, coughs, touches hair or a non–food contact surface with the gloves, the gloves should be replaced. If gloves are torn or cut, gloves should be discarded, hands washed immediately and a new pair of gloves put on. To be effective, gloves should fit snugly but not so tightly that they are uncomfortable or tear. Shirt sleeves should be tucked inside glove cuffs when long sleeves are worn.

Different colour gloves should be designated for different tasks. To avoid cross-contamination, colour-coded gloves should be confined to their designated areas. To make pieces of glove easier to spot in sprouts, they should be a colour that contrasts with the sprouts. Gloves should not leave the assigned processing area and should ***never*** be taken into washrooms, lunchrooms or other areas of potential cross-contamination.

Gloves are most often constructed of vinyl, latex or nitrile. Latex is flexible, less receptive to microbial contamination than vinyl and less likely to leak. However, latex gloves are not as easily washed, and some food handlers may exhibit an allergic reaction to latex. Vinyl is most economical for high-volume use. Nitrile gloves are tough, sensitive and durable but much more costly than vinyl or latex.

Once they have been removed, disposable plastic gloves should **not** be reused. Reusable gloves should be cleaned and sanitized between uses.

Whenever possible, clean, sanitized tools or utensils (instead of hands) should be used to handle food and ingredients. Of course, these instruments should be cleaned and sanitized between uses.

Food handlers may use sanitizing hand dips to minimize microbial contamination on hands and/or gloves. When hand dips are used, stations should be located at every entrance and along employee traffic routes throughout the facility to encourage their use. Dip solution should be monitored regularly for chemical concentration.

In order for hand hygiene programs to be successful, management should continuously train and educate new and existing employees on the importance of following good hand hygiene practices. A small number of periodic, random hand cleanliness verification checks can often improve the diligence with which everyone washes their hands. Laboratory plating of hand swabs will provide a visual image of handwashing effectiveness.

**SOP**

Each of these requirements appropriate to your operation should be included in a written Standard Operating Procedure (SOP). As a condition of employment, every employee should sign an agreement to comply with these standards.

## O1.3 Clothing/Footwear/Headwear

**To prevent or minimize sprout contamination, you should meet this requirement:**

- Clothing, footwear and headwear worn by personnel and visitors in processing and handling areas prevent or minimize the contamination of food, ingredients, packaging materials and food contact surfaces.

**This is how to meet the requirement:**

Contaminants can be transferred via employees' personal equipment such as clothing, footwear, utensils, tools and equipment (e.g., hoses, forklifts, pallet jacks, tape, pens) used during daily activities.

**Clothing**

Employees should begin each workday dressed in clean, sanitary, properly fitting clothing appropriate for the tasks being performed. Clothing should be close fitting with no loose, dangling or frayed material that could contact seed or sprouts or get caught in moving equipment. If metal detectors are used, metal zipper or snap closures that can be spotted by metal detectors are preferable to plastic buttons that cannot be detected.

Clothing should not have pockets above the waist from which pens, pencils, notepads, tools and foreign material could fall. Existing above-the-waist pockets should be sewn shut. Long sleeves should be tucked inside glove cuffs to prevent potentially dangerous liquids from contacting the wearer's arms.

To protect the employee's clothing from becoming soiled, protective clothing such as impermeable aprons or smocks should be worn. Protective clothing should be removed and stored in a sanitary area within the processing area before the employee enters a washroom, lunchroom or change room. This clothing should never be worn outside the building. When moving from "raw" areas (e.g., handling seed bags) to more sensitive product areas (e.g., sprout packaging), protective clothing should be changed to prevent cross-contamination. Disposable garments are ideal for transient personnel such as maintenance workers or visitors.

When the employer supplies protective outer garments, colour coding may be used to distinguish workers in different processing operations. If they are easily identifiable by their clothing colour, employees will be discouraged from straying outside their assigned workstations. As noted in Section O1.7, colour coding workers will also discourage them from performing non-designated tasks. This further reduces opportunities for cross-contamination.

Laundering of protective clothing should be controlled by the sprout producer to ensure adequate cleaning and sanitation. Garments should be able to withstand frequent washing and should be washed only in designated areas away from production and storage areas. Garments should not make contact with the floor during washing and sanitizing procedures. When clean, hang on well-ventilated racks so they can air-dry as quickly as possible.

**Footwear**

Footwear can also transfer pathogens throughout the facility. Non-porous closed-toe footwear should be worn in sprout production facilities. The material should be cleanable. Leather or cloth does not meet either of these criteria. In addition, wet leather and cloth are uncomfortable so the wearer tends to avoid sanitizing foamers and foot bath mats. During cleaning and sanitizing, pant legs should be worn over boots (not tucked inside boot) to prevent chemicals from entering the wearer's boots.

The potential for cross-contamination can be greatly reduced or eliminated by either dedicating footwear to designated areas or decontaminating it each time the wearer moves to and from areas of higher or lower risk. When the decontaminating option is chosen, footwear should be cleaned and
sanitized each time the employee travels from area to area. For example, when travelling from the sprout growing area into the packing area and back again, footwear should be cleaned and sanitized when entering the packing area and again upon re-entering the growing area. To facilitate this, footwear cleaning/sanitizing stations should be located in traffic areas where they cannot be avoided. Many facilities provide footwear brushes, and/or sanitizing footbaths, floor foams, or boot water sprays at each interior and exterior door. Sanitizer concentrations should be routinely checked to ensure effective levels are maintained. This is especially true for foot dips where organic matter buildup can quickly destroy sanitizer effectiveness. Foot dips should be monitored frequently for concentration and volume and changed regularly.

Footwear worn inside a sprout production facility should not be worn outside the facility. At the end of each production shift appropriate storage areas should be provided for footwear.

**Headwear**

All employees handling seed, sprouts or sprout packaging materials should wear proper hair covering. Hair in sprouts may be considered both a quality and food safety issue (for what might be on the hair). Hairnets should cover all hair, including sideburns, in order to prevent hair from contacting exposed sprouts and clean and sanitized equipment, and to keep workers' hands out of their hair. Contrary to what some employees may believe, hairnets are a functional piece of clothing and should be worn correctly; they are not to be worn as a fashion statement. Similarly, all beard and mustache hair should be covered by beard restraints.

**SOP**

Each of these requirements, (clothing, footwear and headwear) appropriate to your operation should be included in a written Standard Operating Procedure (SOP). As a condition of employment, every employee should be required to agree, in writing, to conform to these standards.

## O1.4 Storage – Clothing/Utensils/Equipment

**To prevent or minimize sprout contamination, you should meet this requirement:**

- Clothing (including footwear and headwear), utensils and equipment used in the establishment are stored and handled in a manner that prevents or minimizes contamination of food, ingredients, packaging materials and food contact surfaces.

**This is how to meet the requirement:**

Personal belongings should be stored in lockers or designated employee areas separate from food production and equipment/utensil washing areas. Individual, lockable lockers encourage this practice. Extra clothing, knapsacks, lunches, beverages or personal belongings should be strictly prohibited from the seed storage, sprout production, harvesting and packaging areas to avoid cross-contamination.

Personal item storage areas (e.g., lockers) should be cleaned regularly and kept neat and tidy to promote a "clean" attitude among employees. Cleaning brushes, other cleaning devices, utensils and protective clothing should be clearly marked (possibly colour coded) as to their specific use and area of use. Clean protective outer garments (e.g., aprons) and clean cleaning and sanitation staff garments (e.g., rain suits, rubber boots) and tools (e.g., brushes, brooms, etc.) should be stored in a sanitary environment where they will not become contaminated by processing or cleaning activities before their next use.

**SOP** Storage requirements should be the subject of a Standard Operating Procedure (SOP).

## O1.5 Injuries and Wounds

**To prevent or minimize sprout contamination, you should meet these requirements:**

- Personnel having open cuts or wounds do not handle exposed food, ingredients, packaging materials or food contact surfaces unless measures are taken to prevent direct or indirect contamination of food.
- When injuries or wounds occur during food processing activities, measures are taken to ensure that suspect food, ingredients and packaging materials are disposed of and food contact surfaces are cleaned and sanitized.

**This is how to meet these requirements:**

Employees should be instructed to report wounds/cuts incurred during their daily activities to their supervisor immediately. Aside from food safety issues, such reporting is also a Worker's Safety and Insurance Board (WSIB) regulation.

Employees with minor cuts or wounds, regardless of their source, should not handle food until the injury is completely covered by a secure, waterproof bandage. An impermeable cover should also cover boils or infected wounds or sores that are open or draining. On hands or wrists, that cover should be further covered by a disposable glove. Bandages and coverings should be changed frequently to prevent microbe-laden fluids from dripping onto seed, sprouts, sprout contact surfaces and sprout packaging materials. All bandages should be highly visible (e.g., brightly coloured) and identifiable by a metal detector (if available) so they are easily noticed should they end up in the food product.

A well-stocked first-aid station should be easily accessible so employees can treat and cover minor wounds before being cleared by their supervisor to return to food handling activities.

Should an injury result in contamination of seed, sprouts, sprout contact surfaces and sprout packaging materials (with blood, skin, hair, etc.), all contaminated material should be immediately removed from the production area and disposed of. Affected food contact surfaces should also be cleaned and sanitized before sprout production resumes.

**SOP** The standards appropriate to your operation should be included in a written Standard Operating Procedure (SOP).

## O1.6 Evidence of Illness

**To prevent or minimize sprout contamination, you should meet this requirement:**

- Personnel known or suspected to be suffering from or to be carriers of a disease transmissible through food do not enter any food processing or handling areas, or handle food, ingredients, packaging materials or food contact surfaces without taking measures to prevent contamination.

**This is how to meet the requirement:**

A wide range of communicable disease and infections may be transmitted from infected food handlers to consumers through food. For example, unwashed hands of infected food handlers can introduce *E. coli, Shigella* and *Salmonella* bacteria, Hepatitis A virus and norovirus to sprouts.

Those infected with an infectious disease often begin to shed pathogens into their environment before they show symptoms of illness. They continue to shed pathogens while they are ill and for a period of time after they appear to have recovered. For this reason, food handlers showing symptoms of an active case of an infectious disease or diarrhea should be excluded from duties that involve direct or indirect contact with seed, sprouts, sprout contact surfaces and sprout packaging materials.

Food handlers should be asked to disclose symptoms of diseases transmissible through food to their supervisor before beginning their workday. Because that may not always happen, supervisors should familiarize themselves with the symptoms of infectious diseases so those showing these symptoms can be excluded from food handling areas. (See chart below.) Frequent trips to the washroom may be the most obvious indication of illness.

| Pathogen Transmitted by Food | Common Symptoms |
|---|---|
| *Campylobacter* spp. | diarrhea, fever, abdominal pain, nausea, headache, muscle pain |
| *Salmonella* spp. | nausea, vomiting, abdominal cramps, diarrhea, fever, headache |
| *Shigella* spp. | abdominal pain, cramps, diarrhea, fever, vomiting |
| VTEC (verotoxogenic *E. coli)* | severe abdominal pain, bloody diarrhea, fever |
| *Yersinia* spp. | fever, abdominal pain, diarrhea |
| Hepatitis A | sudden fever, malaise, nausea |

| | |
|---|---|
| Noroviruses | nausea, vomiting, diarrhea, abdominal pain, fever |
| *Staphylococcus aureus* | diarrhea, vomiting |

Individuals with colds resulting in discharges from the nose, ears, or eyes, or who are coughing and sneezing, should not be allowed to work in food handling areas or near seed, sprouts, sprout contact surfaces and sprout packaging materials. The same rule applies to other contagious illnesses (e.g., the flu). Those with visibly infected skin, open sores, or other weeping wounds should not participate in food production procedures unless the wounds are adequately covered (see Section O1.5). This policy should be posted in the work area and discussed with prospective employees at the time an offer of employment is made.

High–health risk candidates are not suitable for work in a food handling environment. Employers should adhere to all requirements of the Ontario Human Rights Code (OHRC) when advertising positions, preparing employment application forms and interviewing. *Hiring? A Human Rights Guide*, prepared by the Ontario Human Right Commission, may be accessed at: www.ohrc.on.ca/en/resources/Guides/HiringGuide2/view. The OHRC also publishes a *Policy on Employment-Related Medical Information* at: www.ohrc.on.ca/en/resources/Policies/PolicyEmpMed/pdf.

According to the OHRC, "requirements or duties for employment should be reasonable, genuine and genuinely related to performance of the job." At the job posting stage, mention of medical status "may unfairly prevent or discourage people from applying for a job." Application forms that ask medically related questions are considered discriminatory. Employment-related medical examinations or inquiries that are part of the applicant screening process are also not permitted.

However, at the interview stage, the employer may expand the scope of job-related questions to determine the applicant's qualifications or ability to perform the essential duties of the job. "The Commission recognizes the fact that it would be advantageous to both the employer and prospective job applicants if the employer were to disclose information on any specific medically related requirements of a position at an early stage of the recruitment process."

Health status issues should not be raised by the employer until after a conditional offer of employment is made. That conditional offer may include a signed verification by the prospective employee that he or she is free from communicable or infectious diseases that could negatively impact food safety. Another condition of employment should be that employees agree to immediately report injuries, wounds or illness to their supervisor. The consequence of non-compliance of these conditions of employment is termination of employment.

**SOP** The standards appropriate to your operation should be included in a written Standard Operating Procedure (SOP).

## O1.7 Access and Traffic Patterns

**To prevent or minimize sprout contamination, you should meet these requirements:**

- Access of persons is controlled to prevent or minimize contamination of food, ingredients, packaging materials and food contact surfaces.
- Personnel follow designated traffic patterns to prevent or minimize contamination of food, ingredients, packaging materials and food contact surfaces.

**This is how to meet these requirements:**

Seed and sprout handlers and others who stray outside their designated areas increase the risk of cross-contamination between sprouts, seed, packaging materials and sprout contact surfaces. Equipment, tools and utensils that travel from one processing area to another are also potential sources of contamination.

**People** Seemingly harmless movement and actions of workers may result in contamination. For example, a knife from a worker's toolbox is carried into the production area by an outside maintenance contractor and laid on a food contact surface (potential microbial contamination). Or a knife is used to open a chemical sanitizer then, without proper cleaning, is used to open a bag of seeds (potential chemical contamination). Or a plastic cap of a pen used to complete records falls onto the fast-moving packing line and, because it is not metal, cannot be detected by the metal detector (physical contamination).

Traffic patterns should be clearly defined, marked and enforced. Food handlers should be restricted to the immediate area of their workstations. Access to their workstations should be as direct as possible, avoiding, if possible, travelling through areas of other production or storage activities. Colour-coded uniforms, aprons or hairnets associates workers with their work area and discourages them from wandering outside their designated areas.

A discussion of traffic flow design may be found in Section E2.1.

Even within clearly defined areas, workers who handle both food and non-food products can be potential sources of contamination. To avoid this potential contamination, some facilities designate food product handlers and non-product handlers. Those designated as food handlers touch only food and food contact surfaces, nothing else. Designated non-product handlers pick up items off the floor and other non–food contact surfaces, and handle squeegees, hoses, pallets and other production tools, but never touch or handle food product. Colour-coded clothing differentiates between those who are allowed to touch food products and those who aren't.

**Equipment/Tools**

Utensils, tools and equipment that move through the facility during production, maintenance and sanitation activities may also be a source of product contamination. For example, a forklift, leaking hydraulic oil (chemical contamination), routinely drives from an unpaved outside receiving area (physical contamination from dust) into the building where it drops off raw product at the start of the production line. On the way to pick up finished product, it carries out a bin of garbage, driving through a backed-up pool of effluent (potential microbial contamination) as it goes. It then drives past the production line to the packing area where it picks up finished product that it deposits in the cooler. In this somewhat exaggerated scenario, there are multiple opportunities for cross-contamination.

Understandably, maintenance personnel are often more concerned with the technical aspects of repair than with the food safety implications. Contractors and temporary employees may be even less food safety–minded. As well, maintenance staff and their tools are often highly mobile within a sprout production facility. This combination can create serious cross-contamination issues.

In larger facilities, maintenance staff and their tools and protective clothing should be confined to specific production areas. In smaller facilities, where this is not feasible, dedicating tools and clothing to specific areas should be

considered. As a minimum, all maintenance personnel should have GMP training in personal hygiene (e.g., handwashing, traffic patterns, hair coverings, protective garments, and eating/drinking/smoking) and sanitation practices.
Following completion of any maintenance/repair activity, there should be a reconciliation of tools, parts, gloves and other materials to ensure that nothing is inadvertently left behind to contaminate food, ingredients or packaging. An assessment of the need for cleaning and/or sanitation of the immediate area should be undertaken by an assigned individual.

Tools should always be cleaned and sanitized between repair or maintenance activities. The challenge here is to find cleaners and sanitizers that are effective without corroding the tools.

**Facility Access**

To minimize the risk of accidental or deliberate contamination of food, ingredients, packaging materials and food contact surfaces, entry into the facility should be controlled during both working and non-working hours.

For workers, delivery personnel, outside maintenance workers, visitors, and others, access to the facility should be restricted to entrances that can be physically or electronically monitored. Many processing facilities require everyone, except facility employees, to sign in and out. Visitors should be identified with badges, dress according to visitor GMP policy and be accompanied by appropriate facility personnel while in food handling areas. To reduce the potential for contamination of finished products, facility tours should originate in product packing areas and end in receiving areas ("clean" to "dirty").

A security system, fencing or other measures may be required to prevent entry of uninvited visitors who are intent on damaging and/or contaminating the facility or food products.

**SOP**

Each of the above operational procedures that are appropriate to your operation should be included in a Standard Operating Procedure (SOP).

## O1.8 Chemical Use

**To prevent or minimize sprout contamination, you should meet these requirements:**

- Chemicals are mixed in clean, correctly labelled containers, in the correct concentrations, and are dispensed and handled only by authorized and properly trained personnel.
- Chemicals are suitable for use within a food processing establishment and when used correctly do not present a food safety hazard.

**This is how to meet these requirements:**

All chemicals used in a sprout facility should be listed in the CFIA's *Reference Listing of Accepted Construction Materials, Packaging Materials and Non-Food Chemical Products*. The list may be accessed at: www.inspection.gc.ca/english/fssa/reference/refere.shtml.

An up-to-date list of stored chemicals and their storage location is highly recommended. Chemical storage areas should always be locked. One-person control of chemical accessibility will create accountability. This may take the form of a designated person in charge with another designated person as the backup. Only chemicals needed within the facility (e.g., cleaners and sanitizers) should be kept on-site.

As much as possible, all chemical products should be kept in their original containers with their original labels. Those that are not should be placed in clean, impermeable containers that are appropriate for the chemical. All containers should be distinctly marked/labelled as to their content. (For worker protection, a Workplace Hazardous Materials Information System [WHMIS] label should also be attached to each container.) All chemical containers should be tightly capped to prevent escape of contaminating odours and to prevent accidental spillage.

Chemicals should be mixed in clean, impermeable containers. These containers should also be clearly marked with the chemical and its concentration.

**Insecticides, rodenticides and other pesticides should be stored separately from cleaning and sanitizing chemicals. The importance of worker training in proper handling, mixing, applying and storing chemicals cannot be overemphasized.**

Grease guns should be labelled to indicate whether their lubricants are food grade or non–food grade. Forklift trucks, pallet jacks and other mobile equipment should be monitored for leaking fluids that are potential cross-contaminants.

**SOP** Each of the operational procedures discussed above that is appropriate to your operation should be included in a Standard Operating Procedure (SOP).

Although Material Safety Data Sheet (MSDS) and WHMIS are outside the scope of food safety, a short discussion may be useful here. The law requires that employers ensure thatcontrolled chemical products (as defined by the Hazardous Products Act)used, stored, handled or disposed of in the workplace are properly labelled;MSDS are available to the workers; and workers receive education and training to ensure the safe storage, handling and use of controlled products in the workplace. Material Safety Data Sheets outline the hazards associated with that particular chemical, first aid measures, handling and storage requirements, personal protection precautions and toxicology. Employers may also wish to provide WHMIS training to those who are authorized to handle chemicals. WHMIS deals with cautionary risk labelling, precautionary measures and first aid measures (in words and universal symbols).

## O1.9 Chemicals Used During Operations

**To prevent or minimize sprout contamination, you should meet these requirements:**

- Chemicals used during operations are handled and stored in a manner that prevents contamination of food, ingredients, packaging materials and food contact surfaces.
- Chemicals used during operations are in appropriately labelled containers or dispensers.

**This is how to meet these requirements:**

Chemicals used in seed storage, sprout production, packaging and shipping areas should be managed in a manner that minimizes the potential for contamination of food, ingredients, packaging materials and food contact surfaces.

Chemicals should be properly labelled to avoid misapplication. Chemical

solutions should always be used at the concentration level and quantity most effective for the designated cleaning, sanitation or maintenance activity. Concentrations that are too low are ineffective. Too-high concentrations risk chemical contamination of seed, sprouts and sprout contact surfaces, and waste financial resources. Always follow the manufacturer's recommended usage guidelines.

Chemical containers should be sealed tightly or properly covered when not in use to avoid accidental spillage. Once use of the chemical has been completed, the unused portion should be tightly capped and returned to a secure chemical storage area. During application of chemicals or chemical solutions, care must be exercised so chemicals are restricted to their intended area. For example, application of cleaners or sanitizers with pressure equipment may create aerosols or oversprays that can contaminate adjoining ingredient storage, sprout production, packaging areas and shipping areas.

Poisons should never be brought into food storage, production, packaging or shipping areas.

Use of excessive lubricant may result in food contamination. Excess lubricant should always be removed before food production activities begin or resume.

**SOP** Each of these operational procedures appropriate to your operation should be included in a Standard Operating Procedure (SOP).

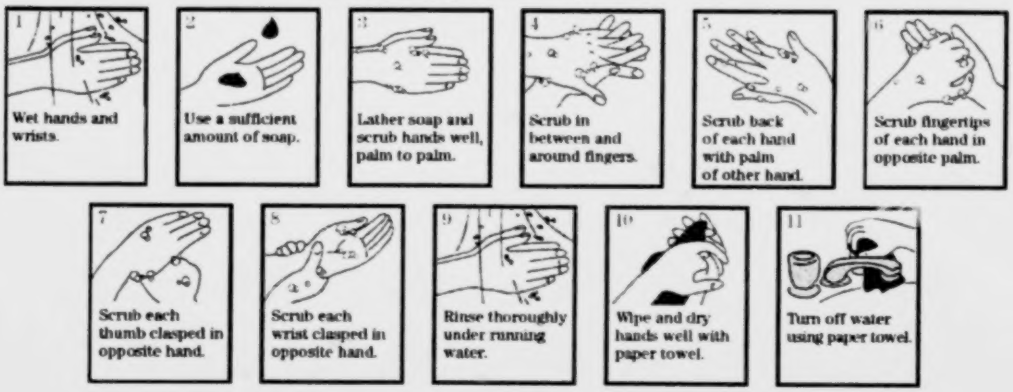
# Handwashing

To wash hands properly, rub all parts of the hands and wrists with soap and water or an alcohol-based hand sanitizer. Wash hands for at least 15 seconds or more. Pay special attention to the areas of the hand most frequently missed.

- Keep nails short.
- Avoid wearing rings.
- Avoid artificial nails or nail varnish.
- Remove watches and bracelets.
- Wash wrists and forearms if they are likely to have been contaminated.
- Make sure that sleeves are rolled up and do not get wet during washing.

If you have any questions regarding cuts, sores, allergies or pre-existing skin conditions, call Telehealth Ontario at 1-866-797-0000, TTY 1-866-797-0007.

## Handwashing with soap and water




## Cleaning with alcohol sanitizers




Ontario

## O2 SHIPPING, RECEIVING, HANDLING and STORAGE

### O2.1 Conveyance Vehicles

**To prevent or minimize sprout contamination, you should meet this requirement:**

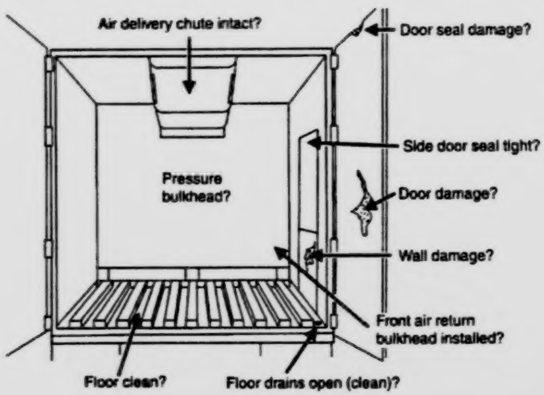
- Conveyance vehicles and containers used for transport of food, ingredients or packaging materials are suitable for the intended purpose and constructed to permit effective sanitation and pest control activities.
- Incoming and outgoing vehicles and containers are assessed before and during unloading and loading to ensure they are suitable for the intended purpose.

**This is how to meet the requirement:**

Transportation vehicles and containers may contaminate seed, packaging materials and sprouts. This can negate all prior efforts at minimizing contamination. Contamination may result from dust, mould or other extraneous material, from chemical residues remaining from previous loads, and from microorganisms due to poor sanitation conditions or cross-contamination with incompatible foods or materials in the same load.

Vehicles used to transport food, ingredients or packaging materials should be used exclusively for that purpose. Vehicles used to transport glass or hazardous chemicals should never be used be used to transport food, ingredients or packaging materials. Regardless of the previous load, a routine trailer washing program should be undertaken between loads.

Before loading or unloading any vehicle transporting seed, packaging materials or sprouts, it should be inspected for cleanliness (inside and outside), state of repair and suitability for the food, ingredients or packaging materials being transported. See diagram below.



Vehicles used for short hauls are often of lower quality than are long distance carriers, so extra attention to vehicle condition may be required. Special cleaning and sanitation should be carried out if raw meat, poultry or fish products have been transported prior to sprouts. All are significant sources of foodborne pathogens.

To facilitate effective cleaning and sanitation, vehicles should be constructed of materials that are readily cleaned and/or sanitized. Surfaces should be constructed of non-absorbent, non-toxic, smooth, corrosion-resistant materials that are able to withstand repeated cleaning. Materials that cannot be adequately cleaned and sanitized (e.g., wood) should be avoided. There should be no openings or cracks that will allow dust and dirt to enter or refrigerated air to escape. Refrigeration equipment (if required) should be in good working order, properly calibrated and equipped with an alarm device in the event of failure. Reefer roof-mounted interior air ducts should be clean and free of defects, and the floor channels should be clean and free of airflow-blocking debris.

Sometimes, vehicles that appear clean have disagreeable odours. These odours should be eliminated before loading takes place to avoid odour transfer to seeds, sprout products and packaging materials. Vehicles should also be dry and be free of condensation.

Ideally, before loading or unloading, the carrier should provide a log of previous loads, as well as proof of cleaning and sanitation procedures undertaken between loads (e.g., a wash ticket). Even then, good judgment is required as to whether the carrier condition is suitable for loading or unloading to be undertaken.

**SOP**

Appropriate conveyance vehicle standards should be included in a written Standard Operating Procedure (SOP).

## O2.2 Loading and Unloading Practices

**To prevent or minimize sprout contamination, you should meet this requirement:**

- Contents of conveyance vehicles and containers are loaded, arranged and unloaded in a manner that protects the safety and suitability of food.

**This is how to meet the requirement:**

Under ideal circumstances, seeds, sprouts and packaging materials would be shipped only as full loads to reduce the possibility of cross-contamination and temperature incompatibility. However, this scenario is not always possible. When incompatible foods or ingredients are shipped together, steps should be taken to keep them effectively separated.

When loading or unloading vehicles, shippers should be aware of potential for cross-contamination from pallets, cartons, bins, and other food containers, as well as from forklift trucks. Unsanitary and/or unsound food containers can contribute physical (dirt, wood splinters, etc.), chemical (pesticide, cleaner or sanitizer residues) or microbial (*E. coli*, *Salmonella*, etc.) contamination. Their use should be avoided. Whenever possible, wood skids should be phased out and replaced by splinter-proof, more easily cleaned plastic skids. The same applies to wooden bins and containers.

Sprouts should be suitably protected and/or packaged prior to shipping. Received seed, packaging material, reusable plastic totes and other supplies should be similarly protected and free from damage upon arrival.

During loading, care should be taken to minimize damage to the shipment, shipment containers and the vehicle itself. Damaged goods should be removed from the shipment immediately, spills cleaned up, and the vehicle cleaned and sanitized, as necessary. Damage to the vehicle should also be repaired before the shipment is allowed to leave. Personnel involved in loading and unloading product should follow good hygiene practices. (See Sections O1.1, O1.2. O1.3, O1.5, and O1.6.)

Loads should be assembled in such a way that they will retain their integrity during transit. Containers should be stacked in an orderly way so they will not be crushed, broken or scattered during shipment. Various types of gates, braces, air bags, load bars and even empty skids may be used to maintain load integrity.

Resist the temptation to pack loads too tightly, especially if refrigeration is required. Always leave air channels, either down the centre or, preferably, along the sides of the load. Tightly packed loads make temperature maintenance difficult, especially when product has not been cooled properly before loading. Overfilling also blocks air circulation, resulting in uneven product temperatures.

Non-food items (e.g., chemicals) should be received at a different location than seed and packaging materials in order to prevent or minimize potential cross-contamination. Where this is not possible, they should be received independently from food, ingredients and packaging materials. After non-food materials are removed from the receiving area, any spills should be cleaned up, debris removed, and the area cleaned and sanitized as necessary before any food, ingredients and packaging materials are loaded or unloaded.

Reusable plastic containers returned after transporting sprouts generally have not been cleaned. They should be treated as a non-food material and unloaded and stored separately from food-use supplies to prevent cross-contamination.

**SOP** Loading and unloading standards appropriate to your operation should be included in a written Standard Operating Procedure (SOP).

## O2.3 Received Products

**To prevent or minimize sprout contamination, you should meet this requirement:**

- Incoming food, ingredients and packaging materials are assessed for evidence of food safety hazards and are controlled to protect their safety and suitability.

**This is how to meet the requirement:**

Shipping and receiving personnel should adhere to good hygiene and sanitation practices. (See Sections O1.1, O1.2. O1.3, O1.5 and O1.6).

Before receiving any incoming ingredients or packaging materials, ensure that they are from known suppliers and match those listed on the purchase order. Unexpected items may be a source of contamination.

As the vehicle doors are opened, note any off-odours. They could result from filth and/or infestation remaining from a previous load, product decomposition, or toxic solvents, petroleum products or chemicals carried with the load but unloaded at a previous stop. Inspect for the presence of insect, bird and rodent droppings and/or urine. Also note the interior temperature. Odours or high temperatures in refrigerated loads could mean the products are unsafe. Such shipments should not be accepted.

All incoming material should be received in an area separate from production areas.

Pallets travel from site to site and are subjected to all kinds of environments. Because their history is unknown, they should be examined for evidence of contamination (e.g., soil, fecal material, chemical stains) before unloading. Because of their porous nature, wooden pallets are higher risk than plastic. Visibly contaminated pallets should not be placed on the floor but either rejected or placed on easily washed plastic pallets.

**Damage**

Broken, crushed or otherwise damaged packages, cartons and similar containers may mean the product was exposed to insects, rodents, harmful chemicals, pesticides or other contamination before it was loaded, or the shipment may have been improperly stacked or mishandled during loading. Taping over holes or repairing damage is an invitation to trouble. Inspect for the presence of insects, rodent and bird droppings, and rodent urine. No matter the cause, damaged or soiled containers should not be accepted.

**Specifications**

Incoming seeds and packaging materials should meet predetermined specifications/standards for food safety and quality. Standards may include physical evidence (e.g., correct temperature; clean, intact, undamaged packaging; proper colour, texture, odour and flavour; no indication of pest infestation, etc.); information supplied by the shipper (e.g., pesticide application records, inspection tags, temperature log, laboratory analysis, etc.); and results tests undertaken by the receiver (e.g., black/ultraviolet light scan for evidence of rodent urine, laboratory analysis of random samples, etc.). In the case of time-consuming laboratory tests undertaken by the receiver, until suitability has been determined, the product should be clearly identified and stored separately to reduce the risk of cross-contamination. Any product that fails to meet these predetermined specifications/standards should be rejected.

Some processors require suppliers of seeds to provide documentation of adherence to Good Agricultural Practices (GAPs). In the case of seeds or packaging materials, sprout producers may ask for proof of adherence to GMPs or HACCP (an internationally recognized, science-based, food safety system designed to prevent, reduce or eliminate potential biological, chemical and physical food safety hazards).

**Chemicals** All non-food chemicals, including chemicals for cleaning and sanitation, pesticides, water treatment chemicals, paints, lubricants, etc., should be listed in the CFIA's *Reference Listing of Accepted Construction Materials, Packaging Materials and Non-Food Chemical Products* at: www.inspection.gc.ca/english/fssa/reference/refere.shtml. If a damaged chemical product is accepted (e.g., leaking chlorine jug), the contents of that container should immediately be transferred to an appropriate container. The new container should be clearly marked as to its contents to ensure that it is used as intended. (A WHMIS label should also be attached for worker safety.)

**Code** All arriving product should have an easy to decipher date code indicating the date of manufacture. Undated materials should be labelled with the delivery date or a use-before date. This will facilitate inventory rotation on a First In, First Out (FIFO) basis. Overstocking perishable commodities increases the opportunity for spoilage and contamination.

Records of received material should be kept, including product lot codes. Receiving records verify the adequacy of incoming material and control over food safety hazards. They also allow for traceability in the event of later food safety or quality issues. For more information on traceability, see Section O8.

Shipping and receiving personnel should be trained:

- In correct receiving procedures
- To determine whether material being received meets established specifications/standards for food safety and quality
- To identify possible issues.

Ensure that the person inspecting the incoming shipment looks for:

- Incorrect product quantities
- Signs of product tampering
- Temperature abuse (intentional and unintentional)
- Lot numbers that do not match the bill of lading

- Seals that are intact and numbers that match the bill of lading
- Off-odours; evidence of pest infestation
- Cleanliness of truck/trailer
- Evidence of incompatible loads e.g., chemicals.

**SOP**

Receiving standards appropriate to your operation should be included in a written Standard Operating Procedure (SOP). The SOP or work instructions for these inspections should be very detailed, including specific procedures to handle any issues identified during the inspection.

An Ingredient and Packaging Receiving Record should be developed. This record may be needed for recall (see Section O6), or traceability (see Section O8) purposes. See Record 1 in Section 5 Records for an example.

## O2.4 Shipping Conditions

**To prevent or minimize sprout contamination, you should meet this requirement:**

- Food, ingredients and packaging materials are protected from contamination, damage and spoilage during shipping.

**This is how to meet the requirement:**

The oldest product should always be shipped first. Lot and/or date coding greatly increases the ability to identify product and the probability of this happening. Product coding is discussed in Section O6.1 Product Code.

**Refrigeration**

Sprouts should be staged for loading in an enclosed, temperature-controlled storage or dock area. Staging time should be as minimal as possible.

Refrigerated vehicles should be precooled to 0° to 4°C before loading begins. Padded door seals on the loading dock help prevent air leakage into the dock and keep airborne dust and insects outside. Dock loading doors and vehicle doors should not be opened until the vehicle is tight against the enclosed loading dock. Food, ingredients and packaging materials should *never* be transported in open-bed vehicles.

Before loading sprouts, the temperature of the vehicle's load compartment should be checked to ensure that it is appropriate to control growth of spoilage microorganisms. All temperature-controlled vehicles should also be equipped with temperature measuring devices and, preferably, a temperature recorder and a warning device. Refrigeration units without recorders and warning devices should be monitored regularly during transport. All temperature readings should be recorded.

Refrigerated vehicles making multiple deliveries should be equipped with a plastic ribbon curtain inside the rear door. This, and unloading as expeditiously as possible, will retain as much cool air as possible when the door is opened. Unnecessary transport delays should also be avoided.

**Personnel Hygiene**

Truck drivers in the shipping/receiving area should comply with the same good hygiene and sanitation practices expected of shipping and receiving personnel.

**Resources**

The Canadian Produce Marketing Association outlines recommended transit conditions (temperature, humidity, ethylene producers, ethylene sensitivity and odour sensitivity) in its *Produce Shipments & Load Compatibility Chart* at www.cpma.ca/Trade/en/shipmentsload.asp. The USDA Agricultural Handbook Number 668, *Tropical Products Transport Handbook* (www.ams.usda.gov/tmd/Tropical/requirements.htm) offers a listing of fruit and vegetable transit and storage temperatures and relative humidity requirements in addition to a number of transportation recommendations.

**SOP**

Shipping procedures appropriate to your operation should be included in a written Standard Operating Procedure (SOP).

## O2.5 Returned and Defective Food Products

**To prevent or minimize sprout contamination, you should meet this requirement:**

- Returned, defective or suspect food, ingredients and packaging materials are clearly identified, stored and controlled for food safety assessment and disposition.

**This is how to meet the requirement:**

Received products (e.g., seed) that have been rejected because they did not meet specifications/standards for food safety and quality should be immediately returned to the supplier. When this is not possible, to avoid contamination of other products, the rejected product should be clearly marked and segregated from accepted product.

The same regime should be followed for sprouts returned from the retailer/wholesaler. These too should be clearly identified and stored in a controlled area isolated from "good" product while awaiting disposal. Any returned sprout products that have left the sprouters' storage or control may have been tampered with, temperature abused or potentially contaminated.

Rejected product handling procedures appropriate to your facility should be included in a written Standard Operating Procedure (SOP).

Although not a food safety issue, product disposal should be environmentally friendly and meet the requirements of all laws and regulations. Contact the Ministry of the Environment for advice, if necessary.

**SOP** Returned and defective procedures appropriate to your operation should be included in a written Standard Operating Procedure (SOP).

A Sprouts Returns Record should be developed. This record may be needed for recall (see Section O6), or traceability (Section O8) purposes. See Record 2 in Section 5 Records for an example.

## O2.6 Allergen Control

### Background

If you have allergens (see allergen list below) in your facility an allergen control program would be required.

**Allergens** Peanuts, tree nuts, cow's milk, eggs, soybeans, finfish, shellfish, and wheat cause more than 90 per cent of food allergies. Sulfites and sesame seeds may also cause allergic reactions. Symptoms may include swelling of the lips, stomach cramps, vomiting, diarrhea, hives, rashes, eczema, wheezing or breathing problems. The most severe reaction can cause death in 10 to 15 minutes. Canadian labelling law requires final-product listing of the 10 potential allergen-causing ingredients noted above. A CFIA Fact Sheet titled *Labelling of Foods Causing Allergies and Sensitivities* is available at: www.inspection.gc.ca/english/fssa/labeti/allerg/allergense.shtml.
Soy is a common and potentially severe allergen. Soybean sprouts do contain soy. No specific cases of reaction to wheatgrass are known, however, environmental allergies to wheatgrass moulds do exist.

**Food plants that use ingredients that contain allergens should meet these requirements:**

- The presence of undeclared allergens in food products is prevented through control of the handling, storage and use of allergenic products and the equipment used in their processing.
- Rework of product(s) containing allergens is controlled.
- Procedures are in place to ensure that ingredient declarations list any allergens contained in the product.

**This is how to meet these requirements:**

The scientific community estimates that food allergies affect approximately one million Canadians (3.3 per cent of the population). In the United States, it is estimated that 2.0 to 2.5 per cent of the population has a food allergy. However, a study released by the American Academy of Allergy, Asthma and Immunology estimates that approximately 1 in 25 Americans (4.0 per cent) is affected by one or more food allergies. Regardless of the actual number, allergens have become a serious food issue during the past few years.

The basic cause of food allergies is the reaction of the immune system of sensitive individuals to some component of a food, usually a protein. Their bodies decide that the particular food is harmful and create antibodies to protect the body. When an individual next consumes this particular food,

the immune system releases massive amounts of chemicals that trigger allergic symptoms.

Food plants should require full ingredient lists from raw material suppliers including those ingredients present in product subcomponents such as flavours or processing aids (i.e., seed sanitizer or sprout fertilizer products). Using this information, a master list of allergens should be developed. Allergens should be identified as such in formulation recipes and their presence noted in production records.

Ingredients and products that contain allergens should be stored in areas designated strictly for that purpose, segregated from non-allergens and non-like allergens. Each allergen should have a dedicated storage area or bin, dedicated dispensing utensil, and dedicated weigh container. Colour-coded containers or tags can make identification of allergen-containing ingredients, bins and utensils easier.

**Control Measures**

Changeover procedures from allergens to non-allergens or vice versa should be described in a Standard Operating Procedure (SOP), monitored to ensure compliance and documented. Production scheduling can include longer production runs that minimize changeovers. Products containing allergens can be scheduled last in a production cycle to minimize the possibility of cross-contamination. Adding the allergenic ingredient into the production process as late as possible decreases equipment exposure time, as well as shortens the time for cross-contamination.

Meticulous cleaning and sanitizing of equipment between allergen-containing product processing and non-allergen product processing can control the presence of allergens. Changeover cleaning should include **all** equipment and utensils, as well as removal of allergenic waste from the facility. A Sanitation Standard Operating Procedure (SSOP) should describe the cleaning and sanitation procedure. Visual inspection and/or test kits that indicate the presence of some allergen residues should be used to determine the effectiveness of cleaning. Records of changeover activities, including verification of the absence of allergen residues, should be maintained.

Tight controls should also be in place to ensure that allergen-containing products are packaged only in properly labelled containers. Ensure that all sprouts marketed are properly labelled including the name of the type of seed being sprouted. Naming each type of sprout contained in a package is particularly important where mixes of sprouts are marketed. Periodically,

label reconciliation should be conducted to ensure that the label accurately reflects the presence of potential allergens. Labels that do not accurately reflect product content should be destroyed. If there is any doubt as to potential allergen content in a finished product, that product should be labelled "may contain _______."

Ultimately, employee training and awareness are the best defence against unintentional allergen additions.

**SOP** If applicable, allergen control procedures appropriate to your facility should be included in a written Standard Operating Procedure (SOP).

## O2.7 Packaging

**To prevent or minimize sprout contamination, you should meet this requirement:**

- Package design and materials protect the safety and sanitation of food and accommodate proper labelling.

**This is how to meet the requirement:**

From a food safety standpoint, packaging should be non-toxic; block entry of biological, chemical and physical contaminants; be compatible with the food it will contain; protect against physical damage; and accommodate proper labelling. In addition to the food safety aspects, packaging assists quality by acting as a barrier to moisture loss or gain, providing a barrier to oxygen, and not allowing product leakage or loss.

Sprout shelf life and quality is extended when packaging keeps humidity high (95 to 100 per cent) but drains excess water. In green sprouts, this is accomplished using perforated, vented or slotted packaging that contains drainage slits or foam pads that absorb moisture or by using "breathable" packaging that allows gas exchange. Micro-perforated polyethylene bags should be used as the primary container for bean sprouts. Research indicates that modified atmosphere packaging (MAP) (5% oxygen + 15% carbon dioxide) extends the shelf life of mung bean sprouts. Regardless of the type of sprout, impermeable barrier packaging hastens sprout deterioration.

New single-use boxes and bags should be the first choice as containers, especially for microbially sensitive sprouts. Often, they are required by regulation. A list of approved packaging materials and their manufacturers

may be found at the CFIA's *Reference Listing of Accepted Construction Materials, Packaging Materials and Non-Food Chemical Products* at: www.inspection.gc.ca/english/fssa/reference/refere.shtml.

The use of staples, which can damage and contaminate packaging materials and food, should be avoided.

All surfaces that contact sprouts (e.g., plastic liners) should be manufactured from food-grade materials to reduce the risk of contamination. Garbage bags are not made of food-grade material and should not be used. Bulk containers (e.g., bins, boxes, totes, etc.) should be designed and constructed so they do not contaminate either food or packaging and can be effectively cleaned and/or sanitized. Surfaces should be constructed of non-absorbent, non-toxic, smooth, corrosion-resistant, food-grade materials that are able to withstand repeated cleaning and sanitizing. Section S6.1, Types of Packaging, contains a more detailed discussion of packaging types.

## Label Requirements

All of the information on food labels should be true (not misleading or deceptive) and accurately describe its ingredients and carry allergen warnings, if applicable. Incorrect labelling can lead to a CFIA-initiated recall.

Retail labels should contain all information required by the Consumer Packaging and Labelling Act and its regulations. It may be accessed at http://laws.justice.gc.ca/en/C-38/index.html. Health Canada's amendments to the Food and Drug Regulations regarding nutritional labelling, nutrition claims and diet-related health claims came into effect on December 12, 2005. (For small manufacturers with gross revenues of less than $1,000,000 from food sales, the reguiations come into effect on December 12, 2007.) During transition to the new regulations, the CFIA's *2003 Guide to Food Labelling and Advertising* may be found at: www.inspection.gc.ca/english/fssa/labeti/guide/toce.shtml.
For guidance regarding allergen labelling, a CFIA Fact Sheet titled *Labelling of Foods Causing Allergies and Sensitivities* is available at: www.inspection.gc.ca/english/fssa/labeti/allerg/allergense.shtml.

Required information includes the common name, a net quantity declaration, the dealer name and address (the "responsible party" to be

contacted in the event of problems), and a list of ingredients.

The common name is described by regulation as "the name by which the food is commonly known" (e.g., mung bean sprouts or alfalfa sprouts). It should accurately represent the composition of the food, not improperly suggest a place of origin, or resemble the name of another product for which it is an imitation or substitute. The common name should be shown on the main display panel in both English and French. There are some exceptions to the English/French regulation; for more details see the CFIA's Consumer Packaging and Labelling Act and its regulations. They may be accessed at http://laws.justice.gc.ca/en/C-38/index.html.

Food products should have a net weight declaration. This applies to all food products regardless of whether they are sold at the wholesale or retail level. The net weight should be declared in metric units on the main display panel in both English and French. Weight numbers should be printed in boldface type and in a size appropriate to the size of the display panel.

The name and address of the responsible party by or for whom a prepackaged product is manufactured or produced should be declared on any part of the food container except the bottom. The address should be complete enough for postal delivery. It may be in either English or French.

Prepackaged sprouts are exempt from regulations that require a durable life date ("best-before" date) on prepackaged foods with a durable life of fewer than 91 days. Some sprouters may wish to provide this information voluntarily or include the production date on the label. This allows the retailer to practise stock rotation (First In, First Out). The same mandatory information (common name, net weight, and the name and address of the responsible party) required on retail sprout labels is also required on wholesale labelling. However, shipping containers containing sprouts for commercial, industrial, or institutional use are exempt from bilingual labelling requirements. Either official language may be used, as well as the language of the client if so desired.

Sprouts packed in bulk that are intended for point-of-sale packaging (consumer purchase at retail) have a different labelling regulation. There are two choices. They may be either labelled with a durable life date and storage instructions **OR** with a packaging date and accompanying durable life information on the label or on a poster next to the sprouts. See the

CFIAs Guide to Food Labelling and Advertising, Chapter 2, 2.11 at: www.inspection.gc.ca/english/fssa/labeti/guide/ch2ae.shtml#2.11.

Prepackaged **multi-ingredient** foods require an ingredient list. If nothing has been added to the sprouts, an ingredient list is not required. Packages of mixed sprouts should contain a list of sprout types included.

Sprouts are exempt from displaying a Nutrition Facts table. This exemption is lost if any health claim is made, including the following: "A healthy diet rich in a variety of vegetables and fruit may help reduce the risk of some types of cancer." However, if the sprouter so desires, nutritional facts may be displayed voluntarily. Nutritional labelling requirements may be found in the CFIA's *2003 Guide to Food Labelling and Advertising* at: www.inspection.gc.ca/english/fssa/labeti/guide/ch1e.shtml.

Labels (or packaging where appropriate) should include information and/or instructions to the next person in the food chain regarding safe handling, display, storage and preparation of the product. For example, a product may require refrigeration. Sprouters may also voluntarily include the words "wash before using." It is a known fact that washing decreases sprout microbial levels so consumers should be encouraged to wash sprouts.

**SOP** Packaging standards appropriate to your product(s) should be included in a written Standard Operating Procedure (SOP).

## O2.8 Storage Practices

**To prevent or minimize sprout contamination, you should meet these requirements:**

- Food, ingredients and packaging materials are processed, handled and stored in conditions that protect their safety and suitability.
- Food, ingredients and packaging materials are rotated to protect their safety and suitability.

**This is how to meet these requirements:**

Non-food supplies (e.g., chemicals, reusable plastic totes, etc.) should each be stored in separate, dry, well-ventilated, pest-free areas away from seeds, the growing area and sprout-packaging area. Whenever possible, different personnel and equipment should handle tasks exclusively in the separated areas to reduce the potential of cross-contamination. When this is impossible, food handlers should change outer clothing/sanitize footwear.

Storage areas should be kept clean and free of garbage and other debris. Sprout storage areas should be free of standing water and condensation from ceilings and from cooling units. Spills should be cleaned up promptly. There should be regular monitoring for telltale signs of rodents and other pests such as insects and birds. When cleaning and repair/maintenance activities are undertaken, seed, packaging materials and sprouts should be removed or covered to reduce the potential for airborne microbial and/or chemical contamination.

Soiled or broken pallets should not be used in storage areas or to transport ingredients or finished product. Where possible, wood pallets should be replaced with plastic, which is more easily cleaned and will not contribute physical debris. Empty pallets should not be stored in close proximity to sprout production, harvesting or packaging areas where they may provide harbourage for pests.

Personnel involved in moving seed, packaging material or sprouts should practise good hygiene and sanitation practices.

Minimize physical damage and subsequent opportunities for contamination by taking care when handling seed, packaging materials and sprouts. Clean up spills immediately and sanitize as necessary. Ideally, all materials should be stored 15 cm above the floor and at least 45 cm away from walls.

There should be a separation of at least 35 cm between pallets. This space will permit improved airflow (allowing faster temperature reduction in coolers), discourage harbourage for pests, allow easier pest monitoring and permit routine cleaning.

Temperature and humidity heavily influence the safety and quality of sprouts. Temperature (0° to 4°C) and humidity (95 to 100 per cent) should be monitored and maintained at levels appropriate to the sprouts. (For a list of storage temperatures and humidities for a number of fruits and vegetables, review the USDA's Agricultural Handbook Number 66, *The Commercial Storage of Fruits, Vegetables, and Florist and Nursery Stock* at: www.ba.ars.usda.gov/hb66. Refrigerated areas should always be precooled before use to speed the cooling process. Product should always be cooled to its optimum storage temperature before being transported. Minimize delays before cooling. Cooling delays allow sprout respiration and metabolism to continue at high rates, encourage water loss, and, most

importantly, increase decay development. The decay may not be apparent for several days until sprout quality and shelf life are negatively affected.

Allow space between containers, use well-vented containers, and stack containers in such a way that air flows past each. Do not overfill storage areas, especially where refrigeration is required. Tightly packed storage makes temperature control and ventilation difficult, especially where quick temperature reductions are required.

Arrange seed, packaging materials and sprouts in a manner that will ease proper stock rotation. Clearly labelling and dating incoming and completed product will help a First In, First Out (FIFO) system reduce the possibility of contamination through spoilage caused by too-long storage. Slow product movement, caused by overstocking, also increases the opportunity for spoilage and contamination.

**SOP** Storage procedures appropriate to your product(s) should be included in a written Standard Operating Procedure (SOP).

A Refrigerated Storage Temperature Record should be developed. See Record 3 in Section 5 Records for an example.

## O2.9 Chemical Storage

**To prevent or minimize sprout contamination, you should meet these requirement:**

- Non-ingredient chemicals and hazardous substances are stored securely and separately from food, ingredients, packaging materials and food contact surfaces.
- Potentially hazardous ingredients are stored in a controlled manner that ensures the safety and suitability of food.

**This is how to meet these requirements:**

Except while in use, all chemicals (e.g., pesticides, herbicides, cleaners, sanitizers, lubricants, etc.) should be stored in designated locations well separated from seed, packaging material, sprouts, and sprout contact surfaces to reduce the potential for cross-contamination. Chemical storage areas should be locked. Metering controls and emptying devices on bulk chemical containers/tanks should also be locked when not in use.

Only trained, authorized personnel should have access to chemicals and

chemical storage areas. A chemical sign-out and sign-in system along with an up-to-date inventory will assist in chemical accountability if more than one person has access. First-In-First-Out (FIFO) inventory rotation should also be practised.

The chemical storage area should be fully enclosed, clean, sanitary and dry. Have adequate ventilation to ensure proper temperature and humidity levels. For the safety of all, incompatible chemicals should be kept separate from each other, stored in appropriate containers, and be tightly capped and correctly labelled (including a WHMIS label).

Only chemicals listed on the CFIA's *Reference Listing of Accepted Construction Materials, Packaging Materials and Non-Food Chemical Products* should be used. The list may be accessed at: www.inspection.gc.ca/english/fssa/reference/refere.shtml.

**SOP** Chemical storage procedures appropriate to your operation should be included in a written Standard Operating Procedure (SOP).

## O2.10 Waste Management

**To prevent or minimize sprout contamination, you should meet this requirement:**

- Waste is handled, stored and removed in a manner that protects the safety and suitability of food.

**This is how to meet the requirement:**

Garbage attracts pests and can develop objectionable odours that can contaminate sprout growing, packaging and storage areas.

In-facility foot baths and/or floor foams may be incapable of eliminating large volumes of contamination picked up by work boots and equipment wheels passing through liquid waste (including runoff from dumpsters). Whenever possible, foot and equipment traffic should avoid travelling through liquid waste. Where this is not possible, arrange to clean, then sanitize, boots and wheels before entering sprout production, packaging and storage areas.

**Solid Waste** Garbage inside the building should be stored in clearly identified (colour-coded), covered, leak-proof containers that are large enough to hold at least one day's garbage. Overflowing, leaking and uncovered waste

containers are a potential source of contamination. Interior containers should be emptied daily (or more often, if necessary) into covered exterior containers that are far enough away from buildings to discourage rodent travel.

To avoid cross-contamination with employees and equipment, care should be taken not to spill waste while emptying containers. Waste should never move through seed storage, sprout production or packaging areas where there is risk of contamination or cross-contamination. If liners are not used in interior garbage containers, the containers should be washed after every emptying to remove odours and debris.

Exterior waste disposal containers should not leak, should always be covered and should be located far enough away from the production facility to discourage rodent travel. Exterior garbage containers should be emptied regularly (minimum weekly) so as not to be attractive to pests.

**Inedible Waste**

This organic waste results from sorting, removing seed hulls, etc. It should be kept separate from seeds, sprouts and packaging materials and clearly identified (colour-coded) in leak-proof containers.

Containers should be placed in locations close to the waste source but not in personnel or equipment traffic routes where cross-contamination is possible. Containers should be large enough to handle the inedible waste generated and should be emptied before overflowing or decay begins. This will prevent odours, discourage pests and reduce opportunities for cross-contamination. As with garbage, this waste should not be transported through sprout processing, handling or storage areas when there is risk of contamination or cross-contamination with food, ingredients and packaging. Containers should be cleaned (and sanitized, if necessary) after each use.

Exterior containers of inedible waste should not leak, should be covered (when feasible) and should be emptied regularly to discourage pests. Dispose of organic waste in an environmentally friendly manner. A protocol exists between the Ministry of the Environment (MOE) and OMAFRA regarding disposal of **agricultural** waste on agricultural properties. Check with the MOE before using this method of disposal. Commercial haulers and composting sites, licensed by the MOE, may also be used for the disposal of inedible food products.

**Liquid Waste**

As described in Section E3.5, sewage and wastewater should be handled by separate disposal systems designed to prevent contamination and cross-contamination of food, ingredients and packaging materials. In some instances, wastewater may be transported from the site by MOE–licensed vehicles to MOE–licensed treatment plants. On-site effluent lagoons or other treatment options may sometimes be used for wastewater if first approved by the MOE. Any disposal system should not create conditions that permit cross-contamination (e.g., through odours) or attract pests.

**SOP**

Waste management procedures appropriate to your operation should be included in a written Standard Operating Procedure (SOP).

## O3 SANITATION

### Sanitation Background

**Why Clean and Sanitize?**

Sprout processing environments that are not adequately cleaned and sanitized can be a source of microorganisms that cause food spoilage and foodborne illness. These food spoilage microorganisms may be bacteria, moulds, yeast, viruses or parasites.

When nutrients and moisture are available and when the environment is favourable (suitable pH, temperature and oxygen level), bacteria, moulds and yeast multiply in food. Viruses and parasites survive in food but depend upon a living host (e.g., the human body) to grow and reproduce.

Food spoilage microorganisms reduce shelf life by causing changes in food colour, texture, flavour and/or smell. These changes make the food undesirable or unsuitable for human consumption. Pathogenic microorganisms, which may produce illnesses or illness-causing toxins, normally do not create any visible changes in food.

Unclean sprout processing surfaces provide an ideal environment for the growth of microorganisms. When seed/sprouts comes in contact with unclean surfaces, food spoilage or pathogenic microorganisms can be transferred to the sprouts being produced. This transfer of microorganisms from a contaminated source to a non-contaminated source is called cross-contamination.

Proper cleaning and sanitation of equipment, work surfaces and utensils will:

- Remove dirt and/or food material that harbour microorganisms

- Eliminate most bacteria, including pathogens
- Prevent cross-contamination
- Extend product shelf life
- Improve food safety
- Increase protection against financial losses.

### What's the Difference?

While the terms are often used interchangeably, **cleaning and sanitation perform entirely different purposes.**

**Cleaning** is the removal of unwanted material (commonly called soils) from production equipment and production areas. Removing leftover particles eliminates many microbes, their food source and other physical debris that can contaminate future batches of food. Appropriate cleaning chemicals may be applied manually or mechanically to equipment that remains assembled (clean-in-place) or that is partially or fully disassembled (clean-out-of-place). Most often, a combination of methods is used.

**Sanitizing** is treatment of a cleaned surface with a chemical or physical agent (e.g., heat) to reduce disease and/or spoilage-causing microorganisms to levels considered safe for public health. By definition of the Association of Official Analytical Chemists, sanitizing a food contact surface should reduce the contamination level of specific bacteria (*E. coli* and *Staphylococcus* are the standard test organisms) by 99.999 per cent (a 5 log[2] kill) in 30 seconds. Non–food contact surfaces require a contamination reduction of 99.9 per cent (a 3 log kill), also within 30 seconds. When microbial populations are reduced to these levels, the surfaces are considered to be microbially clean.

It should be noted that even at three or five log reduction levels, sanitizers do not destroy all pathogens. For example, if there are 1 million bacteria per square centimetre, a 5 log reduction will reduce that number 99.999 per cent so 10 bacteria per square centimetre remain. Some of these may be pathogens or spoilage-causing organisms. Under favourable growing conditions (e.g., food, water, nutrients, and suitable pH, temperature and oxygen level), the population of the surviving bacteria may double every 20 minutes. Other bacteria (again including pathogens) may be partially inactivated by sanitizers but regenerate and become viable again. Therefore, surfaces that are "clean" immediately after cleaning and sanitizing operations may develop high bacterial levels if left undisturbed

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[2] The term "log" is an abbreviation for logarithm. A logarithm is a "power of 10" ($10^1$). Each logarithmic (log) reduction reduces the microbial population by 90 per cent.

for a period of time (e.g., overnight). As a general rule, surfaces left for more than four hours should be sanitized again before production begins.

Undesirable microorganisms (pathogens and/or spoilage-causing organisms) may come from:

- Ingredients (e.g., contaminated seed)
- People (e.g., dirty hands)
- The building (e.g., dirt and condensation dripping from overhead pipes, dirty drains or unclean doorknobs)
- Equipment (e.g., packaging equipment, pallet trucks travelling through the building, dirty buttons and switches, or dirty cleaning brushes)
- Improperly stored trash and product residues
- Non-potable water
- Pools of water on the floor
- Rodents and other pests
- The air (via aerosols)
- Many other sources.

**Biofilm**

Incomplete cleaning/sanitation encourages development of biofilm, which becomes an ongoing source of bacterial contamination from apparently clean surfaces. Both pathogenic and spoilage microbes can form biofilm.

A biofilm is a microcolony of bacteria that securely attaches itself to an inert surface using complex polysaccharide-like material. Once formed, a biofilm provides bacteria with an environment that is favourable to their survival while protecting them from flows of liquids, changes in pH or temperature, and chemical cleaners and sanitizers.

Biofilm can form on the surface of equipment or any other surface that is in continuous contact with food. The microcavities of porous surfaces such as elbows, junctions, cracks and splits are also ideal areas for accumulation of residues and biofilm-forming bacteria.

Once in place, biofilm is extremely difficult to remove or sanitize. Removal often requires sophisticated cleaners with oxidizing agents. The best defence against biofilm development is prompt, regular, complete cleaning and sanitation of all food production surfaces.

A list of acceptable cleaners and sanitizers can be found on the CFIA's *Reference Listing of Accepted Construction Materials, Packaging Materials and Non-Food Chemical Products* at:

www.inspection.gc.ca/english/fssa/reference/refere.shtml. Only these chemicals should be used. If in doubt, contact the nearest CFIA office.

## Cleaner Selection

The choice of cleaning chemicals is determined by:

- The type and/or combination of types of unwanted matter (soils)
- The composition and area of the surface to be cleaned
- The method of cleaner application
- Characteristics of the water used.

### Soils

Residual soils in sprout processing facilities may generally be classified as organic (derived from living organisms) or inorganic (non-living thing). Generally, only organic soils will be encountered in sprout production.

Some organic soils (e.g., sugars, some starches, and most salts) are soluble in water, while others (e.g., protein, fat and oil) are soluble in an alkali. Alkaline chemicals (detergents) are best for removing carbon-based organic soil loads (e.g., food wastes). For protein soils, a chlorinated alkaline detergent is most effective. When chlorine is added to an alkaline detergent, it improves the cleaning effect of the detergent but does not act as a sanitizer.

Moderately alkaline or neutral cleaners are used to remove organic soils. For specific applications, alkaline cleaners are commonly blended with other chemical agents to dissolve, suspend and disperse soils. Typically, these cleaning agents consist of an alkaline cleaner, surfactants and chelating agents.

Moderately alkaline cleaners include disodium carbonate, sodium metasilicate, and tri-sodium phosphate (TSP). Carbonate-based detergents have limited use in food facilities because they interact with calcium and magnesium to form highly insoluble compounds. Silicates are most often included in cleaners as a corrosion inhibitor. TSP has a long history of effectiveness against organic soils. Water conditioners, corrosion inhibitors, and wetting or emulsifying agents may also be formulated into cleaners.

Highly alkaline detergents (e.g., caustic soda or sodium hydroxide, caustic potash or potassium hydroxide) are used in many circulating clean-in-place (CIP) systems. Acid detergents include organic and inorganic acids and are most frequently used in beer- or milk-bottling operations. Enzyme-based detergents are limited to use on unheated surfaces.

Inorganic soils (e.g., hard water scale and most mineral deposits) are soluble in acid chemicals.

Some soils are soluble in water, alkali or acid. Often soils contain mixtures of several components. This further complicates cleaner/sanitizer selection. Biofilms require sophisticated cleaners with oxidizing agents.

**Food Soil Characteristics**

| Soil Type | Solubility | Ease of Removal |
|---|---|---|
| Starch | Water, Alkali | Easy to Moderately Easy |
| Sugar | Water | Easy |
| Fats/Oils | Alkali | Difficult |
| Protein | Alkali | Very Difficult |

Fresh soils are more easily dissolved than are old, dried-on deposits. Using too-hot water or improper cleaners can "set" soils, making them more difficult to remove. Applying the proper cleaner will ease soil removal.

### Surface

Surface composition alters the effectiveness of different cleaning and sanitizing chemicals. Although 300 series stainless steel or food-grade plastic are the recommended surfaces for food production, other surfaces are sometimes used. 300 series stainless steel is corrosion resistant, durable and easy to clean. However, prolonged use of strong acidic cleaners in combination with chlorine may damage stainless steel. 400 series stainless steel is more prone to corrosion than is 300 series.

Food-grade plastics are smooth and impervious. However, effective cleaning may become difficult if the surface becomes scratched, pitted or scored. Pitted, cracked, corroded or rough surfaces may reach a point at which they can no longer be effectively cleaned or sanitized. When this occurs, these surfaces should be replaced.

Wood is easily damaged, creating cracks and crevices that harbour microorganisms. The use of wood is **not** recommended in sprout production facilities.

Iron-based alloys (e.g., carbon steel) are prone to rusting. Acidic cleaning compounds and chlorine sanitizers encourage rust formation. Only neutral cleaners should be used on iron-based or galvanized surfaces. Tin surfaces are sometimes an alloy of tin and lead so their use is not recommended because exposure to lead is known to have adverse effects

on human health.

Painted surfaces have different characteristics depending upon the paint used. **OMAFRA does not recommend painting food contact surfaces.** Regardless of the surface painted, only paint acceptable to the CFIA should be used. See a list of acceptable paints at: www.inspection.gc.ca/english/fssa/reference/refere.shtml.

Acids and acid cleaners corrode concrete floors. Pitted or cracked concrete floors should be sealed with coating acceptable to the CFIA. Acceptable coatings are reviewed at: www.inspection.gc.ca/english/fssa/reference/refere.shtml. Only these coatings should be used. If in doubt, contact the nearest CFIA office.

**Surfaces and Cleaner Summary**

| | |
|---|---|
| Stainless steel | Can use non-abrasive acidic and alkali cleaners; do not use hydrochloric acid or chlorides |
| Plastic | May crack or cloud from prolonged exposure to strong acidic or alkaline cleaners; use moderately alkaline cleaners |
| Nylon | Do not use acidic cleaners; use moderately alkaline cleaners |
| Rubber | Deteriorates with constant use of chlorine; use moderately alkaline cleaners |
| Brass, copper, mild steel | All less corrosion resistant than stainless steel; acidic cleaners encourage steel rusting; use moderately alkaline cleaners with corrosion inhibitors |
| Aluminum | Readily attacked by acidic and highly alkaline cleaners; use only soft metal–safe products such as moderately alkaline cleaners |
| Wood | Should not be used in food applications |
| Iron drains | Acidic cleaners are corrosive; use moderately alkaline cleaners |
| Painted surfaces | Use moderately alkaline cleaners |
| Concrete | Use alkaline cleaners |

**Application**

Chemical cleaners may be applied manually, in a soak solution (i.e., COP-clean-out-of-place, foam), as a low-pressure wash or using an automated CIP (clean-in-place) system. Each application method has advantages and disadvantages. Most sprout production facilities use a manual procedures.

**Manual Cleaning**

Advantages:

- Low-cost equipment required; affordable in small operations
- Adaptable to all types and sizes of facilities, equipment and tools
- Milder, generally safer chemicals used
- Immediate observation of cleaning efficacy

Disadvantages:

- Effectiveness often depends on worker industriousness
- Cleaning can be inconsistent
- Labour intensive
- Mild chemicals required for safe human handling may be ineffective
- Greater opportunity for cross-contamination by workers and tools

**Clean-Out-of-Place (COP) System**

Advantages:

- Minimal labour required
- Longer period of time for cleaner to act

Disadvantages:

- Requires disassembly
- Soak tank often requires agitation to be effective
- Incorrect cleaner can damage equipment because of extended contact time

**Low-Pressure Wash**

Advantages:

- Can be used for both rinsing and application of foam cleaners
- Fast application of cleaners on walls, floors and stationary equipment
- Easier to reach "hard-to-clean" areas

Disadvantages:

- Too-high pressure may cause cross-contamination by aerosols and oversprays
- Low-pressure systems generally require higher volumes of water
- Loss of water temperature during application

**Clean-in-Place (CIP) System**

Advantages:

- Reduced labour required with automation
- More consistent, effective cleaning
- More powerful cleaners can be used
- Optimal use of water and cleaner
- Cleans difficult to access areas (e.g., inside pipes)

Disadvantages:

- Higher capital cost; higher maintenance costs
- Not all equipment can be cleaned in place
- Easy to ignore automated systems; routine monitoring necessary to ensure system is working effectively

Surfactants (SURFace ACTive AgeNT) lower the surface tension of cleaning solutions (effectively making water "wetter"). Without a surfactant, water forms beads, which results in minimal contact with the surface and with soils. This means that the water (and the cleaner that it is carrying) does not penetrate surface crevices. However, a solution containing a surfactant spreads across the surface thoroughly, wetting soil particles and penetrating crevices. The result is more effective cleaning. Surfactants are most often found in manual cleaners. CIP systems, where higher temperatures, stronger cleaners and greater pressures are used, generally do not require added surfactants.

**Water**

Water makes up 95 to 99 per cent of cleaning and sanitizing solutions. It carries cleaner and sanitizer to the surface and carries contamination away from the surface. Water impurities can drastically alter the effectiveness of a detergent or sanitizer. Water used for sprout production, cleaning and sanitizing activities must be potable (must meet Ontario Drinking Water Quality Standards, O. Reg. 169/03), under the Safe Drinking Water Act, 2002. See www.e-laws.gov.on.ca/DBLaws/Statutes/English/02s32_e.htm.

***Water:*** *Mineral Content*

Minerals (calcium and magnesium salts) found in water can negatively affect the performance of cleaners and sanitizers. These salts not only tie up active ingredients, requiring higher application rates, but also may precipitate out as mineral scale. This scale is an ideal place for microorganisms to attach as a biofilm, in which they are protected from cleaners and sanitizers. In addition, scale buildup can reduce heat transfer efficiency and reduce the internal diameter of pipes.

**Summary of Water Hardness**

| Water Hardness Rating | Calcium Carbonate Content (ppm) | Grains per Gallon |
|---|---|---|
| Soft | 0–60 | 0–3.5 |
| Moderately hard | 60–120 | 3.5–7 |
| Hard | 120–180 | 7–10.5 |
| Very hard | over 180 | over 10.5 |

Where hard water is used for cleaning, the addition of chelating or sequestrating agents (a water softener) is necessary. Surfactants are sometimes mixed with water to reduce surface tension (making water wetter) and to help overcome water hardness.

Potential water (and ice) contaminants may be microbial, chemical or physical. While all may cause adverse health effects, microbial contamination is generally of greatest concern.

***Water:*** *Water Content*

Water may contain enteric pathogens (bacteria, viruses and parasites), which can be transmitted to humans. While bacteria do not multiply in pure water, many can multiply in food. Viruses and parasites do not reproduce in food as they require a host.

**Waterborne Pathogens**

| | |
|---|---|
| Bacteria | *Salmonella, Shigella,* pathogenic strains of *E. coli* (e.g., O157:H7), *Vibrio, Heliobacter, Yersinia, Campylobacter* |
| Viruses | Noroviruses, Enteroviruses, Hepatitis A, Rotavirus |
| Parasites | *Giardia, Crytosporidium, Cyclospora, Amoeba, Toxoplasma,* Roundworms, Flatworms, Tapeworms |

***Water:*** *Chemicals*

Chemicals, such as pesticides, synthetic organics, nitrates, arsenic, lead, mercury and asbestos are sometimes found in water. In large enough quantities all are potentially toxic. Chemical contamination can result from chemical spills, incorrect use of pesticides, improper water treatment or cross-contamination with sewage or industrial waste.

Physical characteristics of water including colour, odour, taste, temperature and turbidity (cloudiness) are primarily aesthetic and generally pose very small health risks, but may affect food quality.

The CFIA recommends that municipal water used in sprout production should be tested twice a year by the producer. Water from other sources (e.g., well) should be tested once a month.

Because contaminated water can cause severe consequences, many food processors test much more frequently; some as often as every day.

Private laboratories perform *coliform* and *E. coli* water analysis for a fee in the $25 to $30 range. In addition to bacteria, food processors may also wish to test water for metals, minerals and pesticides.

## Sanitizer Selection

Sanitation may be achieved using either heat (thermal treatment) or chemicals. Sprout growers most commonly use chemical sanitizing.

Sprout production equipment should be sanitized immediately after cleaning and again prior to use, if sanitizing took place more than four hours previously.

### Heat

Hot water sanitizing is commonly used where immersing contact surfaces is practical (e.g., small parts, utensils). Both time and temperature are important.

Depending upon the application, sanitation may be achieved by immersing parts or utensils in 77ºC to 85ºC water for 45 seconds to 5 minutes.

A 45-second immersion in 77ºC water is equivalent to immersion in:

- A 100 ppm chlorine solution for 45 seconds
- A 200 ppm quaternary ammonium solution for 45 seconds
- A 25 ppm iodine solution for 45 seconds.

Larger equipment may be sprayed with the same temperature water for the same period of time. However, it is important to remember that when cooler equipment is immersed in hot water or hot water is sprayed on cooler equipment, the water temperature will decrease rapidly, so killing power is lost. Hot water sanitizing is effective only when appropriate temperatures can be maintained for the appropriate period of time.
Hot water sanitation is easy to apply, readily available, effective for a broad range of microorganisms, non-corrosive, and penetrates cracks and crevices. However, it is relatively slow, can contribute to high energy costs, may contribute to the formation of biofilms, may shorten the life of certain equipment or parts (e.g., seals and gaskets), and can be a safety hazard to employees. Fungal spores will survive this treatment. Because hot water spraying is very energy inefficient and can raise the temperature of the surrounding area, this practice is generally not recommended.

**Chemicals**

There is no perfect chemical sanitizer. Effectiveness depends on:

- Sanitizer concentration (too low or too high is ineffective)
- Surface contact exposure time
- Temperature of the sanitizing solution (generally, 21°C to 38°C is considered optimal)
- pH of the water solution (each sanitizer has an optimal pH)
- Cleanliness of the surface to be sanitized (an unclean surface cannot be effectively sanitized)
- Water hardness.

All sanitizers used in food production facilities in Ontario should be acceptable to the CFIA. The CFIA sanitizer list can be found at the CFIA's *Reference Listing of Accepted Construction Materials, Packaging Materials and Non-Food Chemical Products* at: www.inspection.gc.ca/english/fssa/reference/refere.shtml.

***Chlorine***

Chlorine is the most commonly used sanitizer in food production facilities. The effectiveness of chlorine depends on several factors:

- The amount of turbidity, organic matter, and presence of chemicals such as iron, manganese, hydrogen sulfide and ammonia in the water that "use up" chlorine
- The concentration of the chlorine solution added
- The time that chlorine is in contact with the organism
- The water temperature
- Water pH.

When chlorine is added to water, some of it combines with dissolved chemicals and organic material in the water and is "used up." Only the remaining "free" chlorine (hypochlorous acid) is available to destroy microorganisms present. Free chlorine levels can be easily measured using a commercially available test kit or a chlorine meter. Be sure to measure free chlorine levels, not the total chlorine. Frequent testing will ensure that chlorine concentration is maintained at levels required for sanitation. All measurements should be recorded in a log book.

Non-porous (e.g., metal, hard plastic) food contact surfaces should be sanitized with a 100–200 ppm "free" chlorine solution for a minimum of 45 seconds. A chlorine solution of 600 ppm is recommended for porous surfaces (e.g., wood, soft plastic) but, at this concentration, food contact surfaces should be rinsed afterward. Higher concentrations (e.g., 1,000–2,000 ppm) may be used on walls and floors. Contact time of two minutes

is considered sufficient to reduce pathogen populations to an acceptable level when the surface is free of organic matter.

For safety reasons, it is important to wear protective clothing and eye covering when using chlorine solutions. Also, ensure that the area is well ventilated.

The following formula may be used to calculate the correct amount of chlorine to add to potable water to achieve a desired concentration.

$$\frac{\text{(desired ppm of chlorine)} \times \text{(total water volume [litres])}}{\text{(\% of hypochlorite in chlorine} \times \text{(10,000)}} = \text{amount [litres] of concentrated chlorine to add}$$

Sample calculation:

- 250 litres of 200 ppm chlorine solution required
- Unscented household bleach available as chlorine source (5.25% chlorine)

$$\frac{200 \text{ (ppm chlorine)} \times 250 \text{ (litres)}}{(5.25\%) \times (10{,}000)} = 0.95 \text{ litres required}$$

*Note: For safety reasons always add the chlorine to the water, not vise versa*

The same formula may be used for granular bleach formulations (e.g., 65% calcium hypochlorite).

Always follow the manufacturer's instructions to determine the most efficient chlorine concentration. For example, when chlorine concentration is doubled, microbial killing time is reduced only 30 per cent (e.g., instead of 2 minutes at the manufacturer's concentration, at double that concentration, the killing time is 1 minute and 24 seconds). After sanitizing, allow the surface to air dry.

Temperature also affects chlorine effectiveness. Temperatures should be 24°C or a little higher (e.g., lukewarm/tepid water). Chlorine is ineffective above temperatures of 46°C. **A word of caution: dangerous chlorine gas is released if chlorine is used in hot water.**

Water pH[3] level influences the chorine concentration required for effective sanitation. The optimum pH is 6.5 to 7.0, but chlorine remains effective within a pH of 6.0 to 7.5. **If the pH falls below 4.0, dangerous chlorine gas (mustard gas) is produced.** Water pH should be checked after chlorine is added. pH may be adjusted with commercially available buffers.

Chlorine is relatively unstable, so chlorine solutions gradually lose strength, even in covered containers. This applies to both concentrated liquid chlorine (which has a maximum storage life of approximately six months) and mixed chlorine solutions (which have a maximum storage life of only 24 hours). If it has been stored for a period of time, check the concentration of stored liquid chlorine before mixing. Prepare fresh solutions frequently and check solution strength regularly while in use. Make up only as much solution as you need.

Chlorine is incompatible with most other chemicals. Do not mix chlorine with detergent cleaners. When mixing chlorine solutions, **always add concentrated chlorine to water to avoid possible explosions**; never add water to chlorine.

The most common chlorine-containing sanitizers are sodium hypochlorite and calcium hypochlorite, but chloramines, chlorine dioxide and dissolved gaseous chlorine are sometimes used. Calcium or sodium hypochlorite are commonly used in sprout facilities.

***Iodine/Iodophors***

Iodophors (a mixture of iodine and surfactant) have broad-spectrum activity against bacteria, viruses, yeasts, moulds, fungi and protozoans. Although less affected by organic matter and water hardness than chlorine, iodophors have a limited effective temperature range (24°C to 34°C). They are least effective at low temperatures and vapourize at 49°C. They are most effective at low pH (2.5–3.5) levels. Iodophors have 2.5 times the oxidizing power of chlorine so a lower concentration is required (e.g., 25 ppm). Unfortunately, iodophors can also stain and discolour equipment, especially plastics. They are widely used in the meat industry.

Because iodine/iodophors are non-irritating to skin and have a longer shelf life than chlorine, they are often used in hand-dip solutions.

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[3] pH is a measure (on a logarithmic scale) of the acidity or alkalinity of a liquid. If the pH is below 7.0, the solution is acidic. The lower the number, the greater the degree of acidity. If the pH is above 7.0, the solution is alkaline. The higher the number, the greater the level of alkalinity. A pH of 7.0 is neutral (neither acid nor alkaline.)

### Quaternary Ammonium Compounds ("Quats")

A diverse class of compounds, "quats" are the only sanitizer group with true residual activity. For this reason, they are often used on floors, walls, and drains, and on equipment that will remain idle for longer than 24 hours. Because quats contain surfactants, they can be "foamed" onto vertical surfaces. A concentration of 200 ppm at 24°C to 44°C with a contact time of 45–60 seconds is required for sanitation. Because quats adhere to surfaces, food contact surfaces should be rinsed before use (also depends on concentration used - refer to suppliers instructions).

Quats are non-corrosive, odourless and non-staining; effective on porous surfaces; and work well over a wide pH range. Their effectiveness diminishes in hard water. Organic matter moderately affects their efficiency.

Quats have limited use in processed fruit and vegetable applications. While they are effective at killing yeast and mould, their effectiveness against *coliforms*, *Pseudomonas spp.*, (produce spoilage bacteria), pathogenic *E. coli* and *Salmonella spp.* is limited. They are not compatible with common detergent compounds or chlorine sanitizers.

Compared to chlorine, quats are relatively expensive.

### Phenols

Do not use phenols in sprout growing facilities. Phenol odours can penetrate the sprouts, causing objectionable flavours and odours.

### Peracetic Acid (PAA)

Peroxyacetic acid (PAA) is effective against a broad spectrum of *coliforms*, bacteria, yeast and moulds. It is effective at temperatures from 5°C to 40°C and at a pH up to 8.0. It decomposes to acetic acid (vinegar), water, oxygen and carbon dioxide.

PAA is most commonly used in fresh-cut, further processed, and post-harvest fruit and vegetable flume and wash water systems, especially in applications where high organic matter would significantly decrease the effectiveness of chlorine. Different formulations are designed to be used directly on whole and processed fruit and vegetable surfaces, on food and non–food contact surfaces, and in clean-in-place (CIP) systems. Rinsing is generally not required. PAA can be very expensive.

### Biological Cleaners

Bio-chemical cleaners are a relatively new product used to clean non–food preparation areas (e.g., floors and drains) of fat-oil-grease buildup (FOG). They are formulated using a number of strains of harmless, non-pathogenic bacteria. They work by decomposing and digesting protein, human waste

and other organic matter. As long as a food source is available, the bacteria continue to multiply and eat. When the food runs out, they die. Carbon dioxide and water are produced as byproducts.

***Selecting a Chemical Supplier***

Selection of a cleaner and sanitizer supplier is extremely important. As well as supplying chemicals, the supplier should also be able to provide informed expertise regarding chemical selection and effective use.

More detailed information can be found in OMAFRA's *Foods of Plant Origin Cleaning and Sanitation Guidebook* at: www.omafra.gov.on.ca/english/food/inspection/fruitveg/sanitation_guide/cleaning_sanitation_guidebook.pdf.

## O3.1 Cleaning and Sanitizing

**To prevent or minimize sprout contamination, you should meet this requirement:**

- Cleaning and sanitation procedures are being performed in a way that protects the safety and suitability of food.

**This is how to meet the requirement:**

**Cleaning and Sanitation Methodology**

Good housekeeping practices are critical for effective cleaning and sanitation. Neatness, tidiness and orderliness reduce contamination and make cleaning easier. Good housekeeping should be the responsibility of **everyone** in the facility.

Effective cleaning and sanitation creates production efficiencies. If soil and water are not regularly removed or are incompletely removed during cleaning and sanitation, microorganisms will multiply rapidly. Once the "safe" level of microorganisms is exceeded, the safety of the food product being produced becomes problematic. Therefore, the more effective the cleaning and sanitation, the lower the initial level of microorganisms and the longer the production period before further cleaning is necessary.

Cleaners remove soil and a portion of the microorganisms. Sanitizing, which reduces the microbial population to safe levels, may be achieved through the use of chemicals or by the use of heat (hot water or steam). Because sanitizing requires direct contact between the sanitizer and the microorganisms to be killed, surfaces should be clean before a sanitizing solution is used. The presence of organic matter significantly reduces the killing power of sanitizing solutions.

Equipment should be sanitized immediately after cleaning and again prior to use, if sanitizing took place more than four hours previously.

**The following steps are required for cleaning and sanitizing:**

1. **Preparation of the Area**
   Remove/cover food, ingredients and packaging materials from the area to be cleaned. Cover electrical equipment and other special equipment that could be damaged by water.

2. **Rough (Dry) Cleaning of Area**
   Using brooms, shovels, squeegees, etc., physically remove as much soil and other debris as possible from equipment, utensils, preparation areas and floors. Place in clearly marked "inedible" containers for prompt disposal. In addition to reducing water usage, "dry" cleaning will reduce the risk of cross-contamination caused by water overspray and lessen opportunities for high-risk drain pooling and backups.

   Disassemble equipment, as required. Do not place disassembled food contact surface equipment on the floor. Even if it is cleaned and sanitized before reassembly, its floor "storage" location may prevent complete sanitation. Clean, dedicated carts or racks should be provided to clean and sanitize or to transport disassembled pieces to appropriate soak or circulation tanks for cleaning and sanitizing.

3. **Prerinsing**
   Using 43°C to 50°C potable water, rinse walls from the top down, equipment from the top down and in the direction of product flow, and floors. Don't forget the underside of counters, tables, belts, etc., and other cracks and crevices where soil may be hidden. Use the lowest effective water pressure (increase volume to compensate for decreased pressure) to reduce the risk of cross-contamination caused by aerosols and oversprays. Excessive pressure may also cause machine damage. Where conditions require higher pressures to remove surface soils, high-pressure sprays should be limited to this step during cleaning procedures.

   Following this step, walls, equipment and floors should look clean.

**4. Application of Cleaning Agent**

Apply cleaning agents to loosen any remaining "invisible" soil and keep it in suspension. Apply to ceilings (which normally do not need to be foamed each day), walls, floors and equipment, in that order, at the correct concentration and temperature. This will reduce the potential for cross-contamination and prevent detergent from drying on equipment surfaces. Cleaning solution **should** be applied to every square centimetre of surface including all food contact surfaces and undersurfaces.

Every cleaning agent has an optimum concentration level at which soil removal is most efficient. Too high a concentration is as ineffective as too low a chemical concentration. Always follow the manufacturer's directions carefully.

It is generally assumed that the hotter the water used in cleaning the better the cleaning job. This is true only to a point. A water temperature between 43ºC and 50ºC is best for efficient cleaning. Water that is too hot may cook the soils onto the surface.

Generally, the longer the contact time of the chemical cleaning agent on the surface being cleaned, the better. Check the manufacturer's instructions for minimum exposure time.

Some surfaces may require extra scrubbing. Manual cleaning may include using brushes or other hand-operated equipment to remove soil from surfaces. Cloths and sponges can harbour and spread microorganisms from one area to another, so their use should be avoided. Abrasive materials (e.g., steel wool) may scratch surfaces, leading to eventual corrosion. Abrasive materials may also leave behind tiny metal particles that could end up in the food. Clean, sanitized nylon scouring pads should be used instead. Brushes and brooms with food-grade plastic handles and bristles may be used. Squeegees may be used on floors and walls, but should be constructed of materials acceptable to the CFIA (e.g., food-grade plastic).

Mechanical cleaning may include water hoses with a spray head, pressure-spray devices (high or low pressure using hot or cold water), or steam guns. High-pressure water should be used only after preliminary cleaning has been completed in order to lessen the

possibility of contamination by aerosols caused when high-pressure water hits contaminated surfaces. Pressure sprays should never be used as a final rinse because any resulting cross-contamination will negate previous cleaning and sanitation. During production or mid-shift cleanups, the use of high-pressure hoses can create water droplets or aerosols that can contaminate sprouts, sprout contact surfaces or packaging materials. Their use should be avoided.

Using foaming solutions allows cleaning solutions to stick to vertical surfaces for a longer period of time. Foam should be applied from the bottom up and rinsed off from the top down.

Closed systems require turbulent flow of water, cleaning agents, water, sanitizing agents, and water (in that order) through pumps, valves, connections, pipes and tanks. This is described as cleaning-in-place (CIP). The optimum water temperature is usually 60°C.

Some equipment must be taken apart for cleaning and sanitation. Cleaning out-of-place (COP) requires a soak or circulation tank, which comprises four compartments. Disassembled equipment and utensils are soaked/rinsed in the first compartment, manually cleaned with a cleaning compound in a least 43°C chemical cleaner solution in the second, rinsed in the third in 43° to 50°C water, and sanitized in the fourth with either chemical sanitizers or 77°C water for 45 seconds. In a circulation tank, the velocity of recirculating water, combined with chemical cleaners, cleans equipment parts and utensils. Where three compartment tanks are used, initial cleaning must be "dry." (Refer to Step 2 above).

Don't forget to remove drain covers and to clean inside drains (see "Important Considerations" below).

5. **Post-Rinsing**

Even on vertical surfaces, minute amounts of cleaner may remain after cleaning. (Cleaners are formulated to "stick" to surfaces.) Thorough rising carries away the remaining soil (a biological contamination risk) and the cleaning agent (a chemical contamination risk). Use the lowest effective pressure and volume to avoid aerosols and oversprays. If applicable, rinse the ceiling first. Rinse walls (from the top down) followed by the floor and drains, with equipment and food contact surfaces last (from the top down and in the direction of product flow to keep track of what has

been rinsed). This order will avoid the potential risk of overspray or splashing on equipment that is considered clean. As noted above, only potable water should be used.

While rinsing and reassembling equipment conduct an organoleptic (sight and smell) inspection to check that walls, equipment, utensils, food contact surfaces and undersurfaces, floors, and all nooks and crannies are clean. Use of a flashlight may be helpful. Areas that are not completely clean should be cleaned and rinsed again.

Much of the floor probably will be covered with cleaner when equipment is cleaned. However, it may be necessary to scrub areas that have been missed. Be careful not to use excessive water pressure that may create equipment-contaminating aerosols.

6. **Inspection**

Before reassembling equipment, someone not involved in the actual cleaning should conduct a organoleptic (sight and smell) inspection to check that walls, equipment, utensils, food contact surfaces and undersurfaces, floors, and all nooks and crannies are clean. Use of a flashlight may be helpful. Areas that are not completely clean should be cleaned and rinsed again.

**In a small facility/operation Step 6 may be combined with Step 5. In this case, while rinsing and reassembling equipment the person performing the cleaning will conduct the organoleptic (sight and smell) inspection.**

7. **Application of Sanitizers**

Apply the sanitizing solution at the recommended:

- Concentration
- Temperature
- Contact time.

**Applying the sanitizer at too low concentration and/or for an insufficient period of time can lead to higher bacterial levels and/or to development of resistant strains of microbes.** When this occurs, the area should be "shocked" back to a safe bacterial level by switching to high concentrations of another sanitizer for several days.

Apply sanitizer to floors first. Then move to equipment, beginning with support structures and working upward until all surfaces are completely covered. As with cleaners, sanitize in the direction of product flow to keep track of what has been done.

8. **Post-Rinsing:**
   After the use of some sanitizers and certain concentrations of others, rinsing with potable water is necessary. Rinsing normally eliminates all traces of chemical sanitizers, but only when all surfaces are flushed with a sufficient volume of water.

   After rinsing, the surface should be air dried to eliminate chemical odours. Drying should be as swift as possible to discourage microbial growth. In some areas (e.g., floors), it may be necessary to squeegee off water to speed the drying process. Surfaces should never be dried with a cloth or towel, which can contaminate the freshly sanitized surface with microbes.

   Sophisticated operations may lower the relative humidity in the facility so water evaporates more quickly.

To ensure that cleaning and sanitation activities use correct, consistent procedures at the right time and in the right place with the right chemicals at the right concentrations, written cleaning and sanitizing procedures should be prepared. These procedures are called Standard Sanitation Operating Procedures (SSOP) and are discussed in more detail in the next section.

To ensure that no tasks are missed, a Master Sanitation Schedule outlines the frequency with which each sanitation task is performed (e.g., daily, weekly, monthly, yearly).

After describing the cleaning and sanitation schedule and procedures, the plan should conclude with an assessment of the results and the corrective actions that are to be undertaken if the results are unsatisfactory.

Sprout producers may wish to conduct microbial tests (via environmental swabs, and/or ATP bioluminescence readings) to confirm that food contact surfaces are free from harmful microorganisms. A brief discussion of verification tests follows in Section O3.2.

**SSOP** Cleaning and sanitation procedures appropriate to your facility and equipment should be included in a written Standard Sanitation Operating Procedure (SSOP).

An SSOP should be specific enough that the sanitation crew can complete each cleaning and sanitation activity simply by following the written instructions. This means that cleaning and sanitation activities will be carried out at the right time and in the right place by using the proper procedures with the right chemicals at the right concentrations.

Specific elements should be included in written SSOPs. They are:

- The person/position writing the SSOP
- The date the SSOP was written (may also include the version number to make it easier to differentiate the most recent edition)
- *What* is to be cleaned (e.g., all food contact surfaces, equipment, utensils, floors, drains, walls, ceiling, lighting fixtures, refrigeration units, overheads and anything else impacting food safety)
- *Who* is responsible for cleaning (e.g., trained qualified personnel)
- *Frequency* of cleaning and sanitizing
- Safety equipment (person protection equipment [PPE]) required
- The procedure should include:
  - Steps involved in the cleaning and sanitizing:
    1. Removal/protection of food and preparation of area
    2. Rough cleaning
    3. Prerinsing
    4. Cleaning
    5. Post-rinsing
    6. Inspection
    7. Sanitizing
  - The chemicals and equipment required, including proper handling and application (e.g., chemical concentrations, duration of application and solution temperature)
  - Equipment disassembly and assembly instructions, if applicable
- The name of the record where the activities performed will be recorded.

It is important that SSOPs are current at all times and that the personnel responsible for their implementation are properly trained and informed.

An example SSOP is provided at the end of this section.

**Important Considerations**

It is important to understand that **sanitation is a sequence of steps** with each step building upon successful completion of the previous step. To prevent potential cross-contamination, each step should be fully complete before the next step occurs. For example, if one sanitation worker is performing a prerinse procedure on a machine beside another machine where another worker is doing a final rinse, there is a risk that an overspray from the dirty first machine may contaminate the clean, sanitary surface of the cleaned machine.

**The warmer the temperature, the faster microbes grow** and reproduce and the more frequent cleaning and sanitation are required. As a rule of thumb, for every 6ºC rise in temperature of the food ingredient or product, the rate of microbial growth increases by 50 per cent. For example, at 16ºC, the rate of microbial growth in food debris is 50 per cent greater than if the temperature is 10ºC. The vast majority of human pathogens have optimal growth at temperatures of 25ºC to 40ºC. (The human body is 37ºC.) Note that *E. coli* grow at temperatures as low as 10ºC, *Salmonella* at temperatures as low as 7ºC, *Listeria* and the spoilage bacteria *Pseudomonas* as low as 4ºC. A microbial monitoring program can be used to determine the period of time necessary between cleanups.

Pay special attention to areas where **trapped food and water create ideal growing conditions for microorganisms**. These include cracks in floors, pools of standing water, clogged floor drains, tape used for temporary repairs, exposed insulation, open-design conveyor belts, the underside of conveyor belts, hollow rollers, fixed sleeved assemblies, concave surfaces, and crannies and crevices in poorly designed manufacturing equipment. Each of these areas can provide an environment in which bacteria (including pathogens, if they are present, and spoilage microorganisms) can survive and grow. These areas should be eliminated as soon as possible.

**Drains are an especially high-risk area** because they provide an ideal environment for the growth of the pathogen *Listeria monocytogenes*. To discourage *Listeria* growth, clean drain covers and the inside of drains on a regular schedule. Sanitation personnel who handle drain components should be prohibited from cleaning food contact surfaces or equipment until protective outer clothing has been replaced, footwear has been cleaned and sanitized, hands have been washed and gloves replaced.

As with personnel, **sanitation tools should be limited to specific functions**. To ensure that this happens, **colour-coded tools** should be used. For example, one colour should be dedicated to food contact areas, another

to non–food contact areas, and a third for cleaning drains and other similar areas.

**Certain items require special cleaning and sanitation systems**. For example, dirty control buttons can transfer microorganisms to hands, which, in turn, contaminate food, ingredients, food contact surfaces or packaging. Because control buttons are covered for worker safety during cleaning, a safe, effective cleaning and sanitation procedure should be developed for them.
Another example is that only one side of screens may be readily accessible for cleaning and sanitation. This may create a potential area of cross-contamination. In this case, develop procedures to remove screens or partially dismantle equipment to enable complete cleaning and sanitation. Water and/or chemicals may also penetrate sealed surfaces such as bearings if they are not cleaned and sanitized properly. In addition to causing premature wear, penetration may create an entrance for microbes and provide an inaccessible niche for microbial growth.

**A good pest control program is necessary** for a cleaning and sanitation program to be effective. Pests, including birds, mice, rats and insects (e.g., flies, cockroaches), can contaminate a food production facility with urine and droppings, damage packaging supplies with their gnawing and spread pathogens as they move around the building, equipment and food contact surfaces. Even areas that have been cleaned and sanitized can be recontaminated. Pest control options are outlined in Section O5.

## Automated Versus Manual Cleaning

Automated cleaning systems will improve cleaning by consistently controlling cleaner/sanitizer concentration, solution pH and temperature, cleaning/sanitizer contact time, and the mechanical force used during cleaning. Automated systems also reduce labour hours and reduce cleaning hours. However, manual cleaning requires less capital outlay, and no re-engineering or retrofitting of the facility. The benefits of automated cleaning systems are generally greatest in larger operations with large and/or complex equipment.

When meters are used to automatically mix cleaners and sanitizers, the concentration should be checked regularly with a commercially available test kit to ensure that it is correct.

## O3.2 Pre-operational Assessment

**To prevent or minimize sprout contamination, you should meet these requirements:**

- Operations begin only after preoperational assessment to evaluate the suitability of the environment for food processing and handling has been completed with satisfactory results.
- When sanitation activities are required during operations, a preoperational assessment is conducted before resuming operations.

**This is how to meet these requirements:**

Regardless of the production operation—sanitizing seed, germination, harvesting or packaging—no operation should begin or resume until the production area is checked to confirm cleanliness to prevent contamination of the sprouts. Inadequate sanitation can lead to biological (e.g., bacteria remaining on food contact surfaces), chemical (e.g., sanitizer residues) or physical (e.g., dust and dirt) contamination.

It is not good enough that facility floors, walls and equipment simply look clean; plant, equipment and food contact surfaces should be verified as free from microbial contamination. This can be accomplished only by an effective environmental sampling and testing program.

The locations chosen for environmental sampling and testing are critical. Search out environments that microorganisms prefer. This will include food contact surfaces (e.g., conveyors, utensils, sprout growing equipment), and non–food contact areas (e.g., drains, floors, equipment support framework).

On food contact surfaces, *coliform* or *E .coli t*ests may be conducted. *Listeria, E. coli* and/or *Salmonella* tests maybe performed on non–food contact surfaces. Results from these tests may take one to five days.

ATP bioluminescence (using a luminometer) is a quick and easy indicator if organic matter, i.e. vegetable cells (in which microorganisms can grow), remains on the surface. The luminometer detects adenosine triphosphate (ATP), which is present in all animal, vegetable, bacteria, yeast and mould cells. The presence of ATP indicates contamination by any one of these sources. When ATP comes in contact with the combined luciferin/luciferase reagent contained in one of the tests, a reaction takes place that emits light in direct proportion to the amount of ATP present.

It is a quick method to determine if a surface is clean. Bioluminescence does not indicate how many or what kind of microorganisms or chemical contaminants remain on the surface.

Some producers may also wish to include inspection for pests, and temperature control, and conduct routine equipment maintenance and safety evaluations in their preoperations program.

**SOP** Appropriate preoperation procedures should also be included in a written Standard Operating Procedure (SOP).

An **example** of a Daily Pre-operational Assessment Checklist Record is provided at the end of this section.

## SSOP *Example*

| SSOP 1.0 | Cleaning and Sanitizing - Sprout Packaging Room |
|---|---|

| **RESPONSIBILITY:** | |
|---|---|
| Trained personnel perform the cleaning and sanitizing | |
| **FREQUENCY:** | |
| **Daily**—walls, doors, floor, table, sink **Weekly**—drain **Quarterly**—ceiling, lights | |
| **SAFETY EQUIPMENT (PPE)** | |
| Goggles, gloves, apron, rubber boots, face shield (ceiling) | |
| **PROCEDURE** | **Chemicals and Equipment** |
| **Step 1: Removal of Food and Preparation of Area**<br>• Remove any packaged sprouts and packaging/boxes from the packaging area.<br>• Remove the scales and labeller from the tables. | |
| **Step 2: Rough Cleaning**<br>• Remove all food soils and other debris remaining on the tables and floor.<br>• Place debris in garbage containers, then remove from packaging area. | Squeegee |
| **Step 3: Prerinsing**<br>• Rinse walls from the top down.<br>• Rinse conveyers and tables including undersides of table.<br>• Rinse the floor to remove any remaining food debris. Pay special attention to corners and under the sink and tables. | Low pressure warm water 43º–50ºC |
| **Step 4: Cleaning**<br>• Apply foam from bottom up.<br>• Apply foam cleaning solution to the walls, conveyer, tables, drain and floor.<br>• Apply foam to all surfaces of the equipment and tables including undersides. | Foam cleaner Rinse after 10–15 mins. |
| **Step 5: Post-Rinsing and Step 6: Inspection**<br>• Rinse foam off all areas of the processing area using warm (43ºC) water.<br>• Inspect walls, floors, conveyer, tables for any visible dirt, reclean dirty areas repeating #4 & #5. | Low-pressure warm water 43°–50°C |
| **Step 7: Sanitizing**<br>• Sanitize floor, walls, tables, conveyer and drains; ensure coverage of all surfaces including undersides.<br>• Do not rinse, allow to air dry. | Sanitizer |
| **Step 8:** Complete the Daily Sanitation Checklist Record. | |
| **RECORD:** | |
| Daily Sanitation Checklist | |

| **Date:** | **Version:** | **Written by:** |
|---|---|---|

## Pre-operational Assessment Checklist Record *Example*

### Daily Preoperational Assessment Checklist Record

**Date:** ____________________ **Completed by:** ______________________________

**Instructions:**
1. **Each day**, before production begins the **Production Lead Hand** completes the Daily Preoperational Assessment Checklist Record
2. If the criteria* are met the appropriate box is checked (√).
3. An (X) means that the criteria* have not been met. The deviation and corrective action **should** be documented.

***CRITERIA:** equipment/areas are visibly clean, no off-odours detected

| Equipment/ Area | √ | X | Deviation and Corrective Action Taken |
|---|---|---|---|
| Walls/ Doors | | | |
| Sink | | | |
| Floor | | | |
| Tables | | | |
| Scale | | | |
| Footbath mat | | | |
| Labeller | | | |
| Drain | | | |
| Ceiling and Lights | | | |
| **Additional Comments** | | | |

## O4 EQUIPMENT MAINTENANCE

### O4.1 Preventive Maintenance and Calibration Monitoring

**To prevent or minimize sprout contamination, you should meet this requirement:**

- Preventive maintenance and calibration activities are performed in a way that protects the safety and suitability of food

**This is how to meet the requirement:**

A preventive maintenance program can reduce biological, chemical and/or physical food safety risks, as well as save money on unexpected repair costs, save time from unscheduled downtime and maximize equipment performance.

These are just a few examples of potential food safety risks: microbial risks may result from increased bacterial growth on foods or ingredients stored in a cooler with improper temperature control; worn, cracked gaskets may harbour bacterial growth that is inaccessible to cleaning; worn moving parts, such as disintegrating bearings, may create metal fragments that contaminate seeds and/or sprouts; and equipment designed to meter sanitizers, such as chlorine, may be unable to maintain proper settings, resulting in chemical residues on the final product or ineffective sanitizing.

**What Is It?** Preventive maintenance may include inspection, testing, lubrication, cleaning, adjusting and replacement of parts based on the equipment manufacturer's recommendations and the operating conditions. A written preventive maintenance program should include a list of the equipment requiring regular maintenance and the maintenance procedures and frequencies required. Hidden screens and filters should not be neglected. Only designated, appropriately trained personnel may perform maintenance procedures.

According to a study by the Japan Institute of Plant Maintenance (JIPM), correct and effective lubrication can prevent the majority of mechanical failures and the resulting food safety and quality issues. A colour-coding system where the lubricant container, the application tool and the point of application on the equipment are the same colour lessens the opportunity for error. Equally inappropriate to using the wrong lubricant is using too much or too little of the right lubricant.

A system should be in place that allows workers to report items that require maintenance.

**CFIA Acceptable**

All repair parts and materials used in the production of food should be of food-grade quality. Only lubricants acceptable to the CFIA should be used. A list of acceptable materials and lubricants may be found in the CFIA's *Reference Listing of Accepted Construction Materials, Packaging Materials and Non-Food Chemical Products* at: www.inspection.gc.ca/english/fssa/reference/refere.shtml. The listing is also available through CFIA offices.

**Cross-Contamination**

During extended breaks, (e.g., during repairs to sprout washing or packaging equipment), product integrity should not be compromised. Perishable product should be promptly transported to appropriate storage and "sensitive" product fully covered or removed from the area to prevent cross-contamination.

During maintenance and repair activities, great care should be taken to avoid cross-contamination by workers and by equipment/tools. Understandably, maintenance personnel are often more concerned with the technical aspects of repair than with the food safety implications. Contractors and temporary employees may be even less food safety minded. As a minimum, all maintenance personnel should have GMP training in handwashing, traffic patterns, hair coverings, uniforms, and eating/drinking/smoking policies.

Cross-contamination control may mean separate tools and/or clothing for specific areas of the facility. Following completion of the maintenance/repair activity, there should be a reconciliation of tools, parts, gloves and other materials to ensure that nothing is inadvertently left behind to biologically, chemically, or physically contaminate food or packaging. An assessment of the need for cleaning and/or sanitation of the immediate area should be undertaken by a trained individual.

Temporary repairs should be just that. Materials inappropriate to food processing areas can soon become the cause of contamination. For example, something as innocuous as duct tape may quickly fray and fall into food products where it may not be easily detected.

Records of all maintenance activities should be kept. Records will verify the effectiveness of the maintenance program and should include identification of the equipment, the maintenance activity, the date, the person performing the maintenance, and the reason for the maintenance activity. For a larger facility a work order system may be an effective maintenance reconciliation tool.

**Calibration/ Adjustment**

Calibration ensures that equipment measures or monitors accurately and consistently. Correct calibration will ensure production of a safe product in accurately measured quantities. For example, an improperly calibrated cooler thermostat that reads 4ºC below the actual temperature can create an environment inside the cooler that encourages bacterial growth on sprouts.

Devices that need periodic calibration may include pH and chlorine reading devices, thermometers, temperature recorders, timing devices, pressure gauges, scales, metering devices, temperature control units, metal detectors and luminometers. Manufacturers of measuring and monitoring instruments have written calibration methods and frequencies. These procedures should be followed carefully by appropriately trained personnel. Manual confirmation (e.g., comparing the chlorine concentration reading of a commercial chlorine test strip with a reading from the measuring device) will provide some degree of confidence that the calibration is correct. Critical devices such as metal detectors and scales should be calibrated by an accredited outside agency or the manufacturer at predetermined frequencies to ensure their accuracy.

Keep records of all calibration activities. Should food safety, quality or other issues develop with finished product, improper calibration and the resulting improper measurement may be determined as the cause.

**SOP**

Maintenance/calibration procedures appropriate to your facility should be included in a written Standard Operating Procedure (SOP).

An Equipment Calibration Record should be developed.
See Record 4 in Section 5 Records for an example.

## O5 PEST CONTROL

### O5.1 Pest Control Monitoring

**To prevent or minimize sprout contamination, you should meet this requirement:**

- Pest control procedures are performed in a way that protects the safety and suitability of food.

**This is how to meet the requirement:**

Pests including birds, mice, rats and insects (e.g., flies, cockroaches) contaminate the sprout processing facility with urine and droppings, damage packaging supplies with their gnawing, and spread a variety of pathogens as they move around the building, equipment and food contact surfaces. Even areas that have been cleaned and sanitized can be recontaminated.

**Discouraging Pest Entry**

All pests require moisture to survive. Therefore, roofs should be watertight, and walls and foundations should not allow water to enter the building.

Birds can be kept out of the building if doors and windows are tightly fitted and kept closed. Any other openings in the walls, foundation, eves or roof should also be repaired, sealed or screened to discourage pest entry. Except when in use, keep all doors closed at all times.

Mice can fit through openings as small as 6.5 mm. If a pencil can slide under the door, mice can enter. Openings around vents, wires, pipes and drains should be sealed with sheet metal, wire mesh, silicone caulking or concrete. Mice can jump up to 0.3 m high and can climb vertical surfaces, so all building openings, including those around doors and windows, should be tightly sealed using silicone caulking.

Mice and rats are discouraged by open spaces. A minimum 75-cm wide vegetation-free, debris-free, gravel, concrete or bare-soil open space should border the outside of all buildings. Eliminate food sources attractive to pests, such as garbage. Store garbage and recycled goods (e.g., cans, cardboard, paper, etc.) far enough away from the building to discourage rodent travel between the two.

Cracks and crevices are ideal areas for insect breeding and harbourage, as are small spaces between cabinets and equipment (e.g., a 6-mm space between a cabinet and wall or a 2.5-cm space between equipment and the floor). Cabinets should be sealed tight to the wall. If this is not possible, a minimum 15-cm space should be left between cabinets and equipment and walls and floors.

Without proper housekeeping, effective pest control is impossible. Remove trash, debris and clutter that rodents find desirable for hiding and nesting, and eliminate food sources such as garbage. Accumulations of debris also provide escape routes. According to studies by the Alberta Department of Agriculture, Food and Rural Development, mice travel in an area up to 9 m from their nests in search of food, shelter and water.

Cockroaches and their egg capsules can be carried into buildings inside packages, boxes and recycling bins (even those containing non-food supplies). Inspection criteria for incoming supplies (described in Section O2.3) should include monitoring for cockroaches.

Cockroaches live in high-humidity, food-accessible, ground-level areas where they can hide in cracks and crevices that touch their bodies from both above and below. Elimination of living and harbourage areas deters their presence. A cockroach sighting during daylight is a sign of widespread infestation of the facility. When buildings are heavily infested with cockroaches, the excess population may migrate to outside garbage containers and dumpsters.

Food that cannot be stored in rodent-proof containers should be stacked on pallets 35 cm apart, 45 cm away from walls and 15 cm off the floor.

Where practical, air curtains at doors discourage entry of flying insects.

**Pest Monitoring Outside the Building**

There should be routine monitoring outside the facility for evidence of pest activity. Evidence may include nesting activity within 9 m of the facility. The presence of rodent droppings indicates that a nest is nearby and that control measures should be taken. There may be decomposed rodents or animals in bait stations. Burrowing, urine stains, footprints or evidence of gnawing are also indications of pest activity.

Monitoring should include verification that outside pest control devices are in good repair and in working order, and have the right amount of fresh bait. Exterior traps should be routinely monitored at least once per month.

Garbage dumpsters and other garbage storage areas should also be monitored regularly for evidence of pests or their activity. A discussion of proper waste management may be found in Section O2.10.

### Pest Monitoring Inside the Building

As outside the building, decomposed rodents or animals in bait stations inside the building are evidence of rodent activity. Urine stains, footprints or gnawing are also indicators of pest activity. Insects or flies on ingredients, food products, equipment or garbage, and/or insect, fly, rodent, or bird excreta inside the building, also indicate that pests are present.

A bright flashlight is a useful tool for examining dark, undisturbed or remote areas for signs of dark-loving rodents and cockroaches. Sticky traps, strategically placed near food sources, are often used to monitor for the presence of cockroaches.

Monitoring should also include verification that each pest control device is in good repair and in working order. Where no evidence of rodents has been discovered, interior traps should be routinely monitored at least twice per month. Where evidence has been found, traps should be monitored daily.

Storage and processing areas should be kept clean and monitored regularly for telltale signs of mice or rats. Rodent droppings should be cleaned up immediately for sanitation reasons and to make new rodent activity easier to spot. If evidence of rats or mice is detected, control methods should be used.

### Rodent Traps

**Poison bait should never be used inside the building** where it can contaminate seed, sprouts, packaging or equipment, and endanger workers.

Snap traps are inexpensive, effective, and humane, and eliminate the need for hazardous poisons within the facility. Traps should be placed close to walls, behind objects, in dark areas and in places where rats or mice have been detected. Traps should be spaced approximately 8 m apart around the interior perimeter of the facility including employee areas, dry storage areas, coolers and processing areas and within 3 m of each exterior door.

Position traps so the rat or mouse passes over the trigger in its normal travel path but not in areas where the traps may contaminate ingredients, food products, packaging or equipment. Use plenty of traps so the problem can be eliminated quickly before the mice or rats become trap shy.

Glue traps, sticky boxes or tube traps may also be used. Unlike snap traps, they do not kill instantly. Be prepared to deal with live rodents if these traps are used. Wear heavy gloves to transfer trapped rodents to a bucket of soapy water where they may be disposed of by drowning.

Draw a map of the location of each device so that none are inadvertently missed during monitoring and servicing.

**Rodenticides**

Rodenticides are chemicals that should be used only outside the building. They may be anticoagulants or non-anticoagulants. All rodenticides used in Ontario must be registered under the Pest Control Products Act and Regulations (http://laws.justice.gc.ca/en/P-9/index.html ) and used in accordance with label directions. A list of CFIA-accepted pesticides, including rodenticides, can be found on the CFIA's website at: www.inspection.gc.ca/english/fssa/reference/refere.shtml.
These pesticides should be properly labelled and stored in a locked area. Poison bait should never be used inside the processing facility where it could contaminate seeds, sprouts or packaging material.

Exterior bait stations should be placed no more than 16 m apart and near openings and in places where rats and/or mice are active. Traps or bait stations should also be placed within 3 m of exterior doors, on both sides. Bait should be checked often for freshness, and old or mouldy bait should be replaced. Bait stations should be clearly marked and tamper resistant (require a tool to open) to safeguard people and pets. To prevent them from being moved (or removed), secure bait stations by attaching them to a patio block, chaining them to the building or anchoring them to the ground. Bait stations should not be placed in public areas.

Exterior traps should be monitored often. Dead rats and mice should be removed (wearing gloves to avoid personal contamination) and bait replenished (again wearing gloves).

All pest control chemicals must be used in accordance with label directions.

One problem encountered with rodenticides is that dying mice and/or rats may enter the building then die. When cleaning up dead rodents, or even rodent droppings, several precautionary steps should be taken. Never dry sweep. Dry sweeping rodent droppings can cause dust containing viruses to become airborne. Always wear rubber gloves. Thoroughly spray droppings and the surrounding area with a 5,000 ppm chlorine solution (1 part 5.25% household bleach to 10 or 11 parts water). After spraying, clean the area and place all debris in the garbage.

Rodent droppings should be cleaned up immediately for sanitation reasons and to make it easier to spot new activity.

**Dogs and Cats**

Dogs and cats are an ineffective method of rodent control and they are not generally considered to be pests. However, they too are capable of carrying biological and physical contaminants. Under Section 59(e)(ii) of Regulation 562 of the Health Unit–enforced Health Protection and Promotion Act "every room where food is manufactured, prepared, processed, handled, served, displayed, stored, sold or offered for sale is kept free from … live birds and animals." Therefore, pets must be kept out of sprouting facilities.

**Insect Traps**

Flying insects can often be controlled with light traps. Low-voltage traps consist of an attracting light, a replaceable sticky board onto which the insect becomes attached and a bottom tray to catch insects that do not remain attached to the sticky board. Traps should not be hung directly above seeds, sprouts or food contact surfaces. To remain effective, glue boards should be replaced regularly. High-voltage light traps electrocute insects and often cause them to explode. For this reason, they should not be used within 9 m of exposed seed, sprouts or food contact surfaces or within 3 m of packaged product.

Insect control devices may be used near exterior entrances but should not be positioned so that they attract insects from outside the building into the building. Exterior lights should also be positioned away from the building to discourage insects from swarming near the building.

**Pest Control Operator**

In many instances, pest eradication is best left to a certified pest control operator (PCO) who is licensed by the Ontario Ministry of the Environment (MOE) under regulations of the Pesticides Act. PCOs have the training, expertise, experience and equipment required to ensure an effective pest control program.

Sprouting facility operators who undertake their own pest control activities should be fully committed to consistent application of the program. Too often the responsible person is diverted to other more "important" tasks, is ill, goes on vacation, quits, etc. This creates unacceptable lapses in pest monitoring and control. Facility personnel should also be trained in the safe handling of pesticides and be licensed to purchase and use them.

To facilitate effective pest monitoring and control, a **written pest control program should be developed**. Such a program should:

- Assign a staff person to be responsible for pest control or choose a pest control operator (PCO).
- Outline the responsibilities and activities of the staff person or PCO.
- Schedule pest control activities.
- Specify the pesticides and mechanical devices to be used.
- Include a map indicating the location and type of each internal and external pest control device (e.g., glue boards, insect light traps, tin cats, mechanical traps, etc.), with each numbered for ease of tracking.
- Outline the documentation required to record the chemicals used, where these chemicals were used, any signs of pest activity, the corrective action taken in the event of pest activity, and the signature of the PCO as verification of his or her activity.

In addition to the pest control program, the pest control file should include current licences and insurance documentation of the PCO (if one is employed) or the licences/qualifications of the staff person performing the pest control tasks.

**SOP** Pest control procedures appropriate to your facility should be included in a written Standard Operating Procedure (SOP).

A Pest Monitoring Record should be developed.
See Record 5 in Section 5 Records for an example.

## O6 RECALL

### Background

Sprouts that are unsafe to eat (e.g., they may make some people ill) or are in violation of legislation (e.g., improperly labelled) must be removed from the marketplace. If they have been distributed and are no longer controlled by the producer, the process of removing these sprouts from the marketplace is called a "recall."

A recall may be instituted by either the food producer (e.g., as a result of customer complaints, negative microbial tests, etc.) or by the CFIA (e.g., negative microbial or chemical tests, unreported allergens, incorrect labelling, etc). Regardless of the instigator, a recall program must ensure that product identified as defective is removed from the market as efficiently, rapidly and completely as possible.

**CFIA Recall** CFIA food recalls are classified based on the degree of risk to consumer health.

- A Class I recall is a situation in which there is a reasonable probability that the use of, or exposure to, the product in question will cause serious adverse health consequences or death.
- A Class II recall is a situation in which the use of, or exposure to, the product in question may cause temporary adverse health consequences or where the chances of serious adverse health consequences are remote.
- A Class III recall is a situation in which the product is unlikely to cause any adverse health reaction, but one that violates labelling or manufacturing regulations.

**The CFIA Office of Food Safety and Recall reporting number in Ontario is (416) 973-8724.**

**The number is in operation seven days a week from 8:00 a.m. until 11:00 p.m.**

When the CFIA orders a recall, it will ask for the following information:

- Recalled product identification—description of the product, code(s) or lot number(s)
- Production details—total quantity produced, quantity on hold
- Distribution details—number of units packed with their code(s), number distributed, dates(s) distributed and number remaining in the producer's possession
- Names, addresses, and contact information of retailers and wholesalers where recalled product has been distributed
- Information on any other product that may also be affected by the same hazard
- Contact information for the reporting producer.

## O6.1 Product Code/Label Monitoring

**The requirement for product code and label monitoring is:**

- Food products stored within or shipped from the establishment are correctly labelled and coded with a lot code or production identifier.

**This is how to meet the requirement:**

**Recall Program**

A written recall program should include:

- The person(s) responsible for coordinating and implementing a recall
- Procedures to identify, locate and control the implicated product
- Measures to investigate violation causes and steps to control them
- Procedures to test effectiveness of the recall at predetermined intervals.

Potential recall team members and their possible responsibilities during a recall may include:

**Recall Coordinator** (e.g., Quality Control/Quality Assurance)
- Assists in identifying the problem, assessing the risk, and providing laboratory results or data
- Documents recall activities
- Identifies any product on hand/places on hold
- Retains sample (send for testing if applicable)
- Performs follow-up investigation of incident and recall effectiveness

**Receiving**
- Provides information (receiving records) on the receipt of raw materials and how much may still be on hand (if applicable)

**Production**
- Provides information (production records) on when and where materials were used, quantity and production dates

**Sales**
- Provides contact information for customers
- Contacts customers
- Arranges for product return

**Purchasing**
- Contacts suppliers (if applicable)

**Shipping**
- Provides distribution records for product shipments and identifies quantities of finished goods remaining in stock

**Management**

- Communicates with regulatory agencies
- Interacts with media

The following recall team information form should be developed and be kept up-to-date.

- Name,
- Employee Position
- Alternate Person e.g., name of a replacement individual in the event that the person is not available
- Business phone/cell,
- After Hours phone/cell,

For additional information a *Food Recalls: Make a Plan and Action It! Manufacturers' Guide* has been prepared by the CFIA. It may be accessed at:
www.inspection.gc.ca/english/fssa/recarapp/rap/mgguide.shtml

**Product Distribution**

When the CFIA initiates a product recall, it does so because it feels there is an immediate health hazard to consumers. Therefore, it is essential that the hazardous product be located quickly and completely. That includes product in the hands of wholesalers, distributors, retailers, and product still held by producers.

The distribution record should be product and lot code specific. The list should include:

- Name of the account, street address, city, province
- The product name and lot code
- The type of account (manufacturer, distributor, retailer)
- Contact person at the account
- Telephone number(s), fax number, e-mail address
- Amount and type of product shipped to each account.

The list should be complete and easily readable. In the event of a recall, the list must be provided to the CFIA within 24 hours of the ordered recall. The distribution records should be kept for a period of time that comfortably exceeds the shelf life of the sprouts shipped.

It is not necessary to identify individual retail customers. If the health consequences of consuming the product are considered serious, a public food safety alert will be issued or ordered by the CFIA.

**SOP** Each of these requirements that is appropriate to your operation should be included in a written Standard Operating Procedure (SOP).

A Sprout Distribution Record and Retail/Wholesale/Distributor Information list should be developed. See Record 6 in Section 5 Records for an example.

**Product Code** Product coding is essential for product traceability and recall. Refer to Section O8 for additional information on traceability. Product coding allows for specific lots of sprouts to be located and identified in the event of a recall or consumer complaint. The daily quantity of sprouts packaged and the corresponding lot code should be documented on the Sprout Packaging Record.

A "lot" is defined as a group of products processed under similar conditions and in a similar time frame. That time frame should not exceed one day. For example, all the packages filled with sprouts germinated on the same day in the same room from the same seed lot could have the same lot or code number. Those germinated the following day in another room would have a different lot number/code, even if they originated from the same lot of seeds.

A lot code is any combination of letters, numbers, or both, that can trace the sprouts' manufacturing history and their distribution.

Coding can be as simple or complex as the producer wishes to make it. As long as the identification is permanent, legible and distinguishes that lot from all others, it is acceptable. In its simplest form, it may be the date packed; for example, 080907 or AU0907 (month, day, year), or 070908 (year, day, month), or 22207 (the same date using the Julian calendar).

Some growers may wish to include more information in their lot numbers/codes to easily trace the sprout's history. If that is the case, codes become more complex. For example, suppose the seed used was part of lot "H1003," germination took place in room "B", and the sprouts were packed on August 9, 2007. This information combined might produce code number H1003B080907. The more information in the lot code number, the easier trace-back should be.

Other growers may want to configure their code to keep information secret from their competitors. As long as the code can be referenced to a master

list containing the required information, such a code can be used. For example, the lot code may be S462347. According to the master list "S" is the seed grower Smith Seeds, "46" identifies seed lot H1003, "2" is the sprouting room number, and "347" is the facility's 347th shipment of sprouts since the business began. The master list shows that shipment happened on August 9, 2004.

To facilitate successful product recovery, all products should be clearly identified with a permanent, legible code or lot number for traceability. If the food product in question does not have a unique identity code, it cannot be separated from all other similar product. If it cannot be separated, corrective actions may be taken against *all* similar products.

A code or lot number should meet the following criteria:
- It should be permanent and legible at all times.
- The meanings of the codes should be explained in writing and be readily available.
- It should facilitate product tracking.
- The code may be for a maximum of one day's production.

Product identification and accompanying production records should permit trace-back to incoming raw ingredients and packaging materials, and to potential contamination points during production, processing and/or packaging. These records may also be used as a tool to investigate wholesale and retail customer complaints that do not result in a recall.

Product code information, distribution records, and customer and employee contact lists should be kept current and should be readily available. Responsibility for managing these lists should be assigned.

Once the defective or suspect product has been returned to the processor, this product and remaining inventory of the same lot(s) should be clearly identified and isolated in a designated area. All products within the identified code(s) should be accounted for, including everything that has been sold, recalled or remains in inventory. If the CFIA initiated the recall, it will ultimately decide the fate of the recalled product.

**SOP** Coding practices appropriate to your product(s) should be included in a written Standard Operating Procedure (SOP).

A Sprout Packaging Record should be developed.
See Record 7 in Section 5 Records for an example.

**Complaint File**

A system of documenting complaints is a useful tool for the sprout grower to identify potential food safety and/or quality issues before they become unmanageable.

Complaint records should include the following information:

- The complainant's name, address, and telephone number.
- The problem with the product (e.g., illness, chemical taste, physical injury, substandard product, etc.).
- Product details (e.g., product name, package type, size) and identifying code.
- Whether the complainant still has a sample of the product.
- The name and address of the store where it was purchased.
- The date of purchase.
- Details of how the complainant stored and handled the sprouts after purchase.
- Details of any illness or injury claimed by the complainant to be caused by the sprouts. This should include the time and date the sprouts were consumed, the number of persons consuming the product, the amount of product consumed, the number of person(s) who became ill or injured, the ages of the person(s) who became ill or injured, the time the person(s) became ill, the symptoms of the illness in sequence or a description of the injury, details of contact with a physician, and the current status of the illness or injury.
- Whether the complaint has been referred to anyone else (CFIA, local Health Unit, etc.).
- Details of response to the complainant.

When a complainant complains of any type of illness, he or she should be urged to see a physician. This should be standard policy. Do NOT give medical advice for which you may ultimately be held responsible!

Any complaint should be promptly investigated. If there are concerns regarding the safety of the product, for consumers' and the producer's own protection, any sprouts from the lot in question that remain under the producer's control should be quarantined until the investigation has been completed.

The investigation should determine:

- Where during growing, harvesting, packaging, storage or distribution the problem occurred.

- If the problem could affect other products. If so, those products should also be investigated.
- The cause of the concern.

Results of the investigation should be noted. The report should include:

- The name of the person who conducted the investigation.
- The date and time of the investigation.
- Findings of the investigation.
- A list of other sprout batches or other products that could be affected.

At the conclusion of the investigation, questions must be asked. Is the problem food safety related or is it a problem unrelated to food safety? Have any legislative regulations been violated? Does the problem fall within the jurisdiction of the CFIA, or is it a matter that can be dealt with internally? Is the problem serious enough to warrant a recall?

Regardless of the investigation conclusion, operational changes required to prevent a repeat of the problem should be instituted as quickly as possible. All corrective actions should also be recorded. The complainant should also be made aware, in general terms, of the finding of the investigation.

## O6.2 Mock Recalls

**You should meet these requirements for a mock recall:**

- Written recall procedures are tested by conducting mock recalls.
- Mock recalls are effective in determining where a particular product lot/shipment is within a specified time frame.
- Mock recalls are conducted by trained personnel at a frequency adequate enough to ensure the recall system is up to date and functioning properly.

**This is how to meet these requirements:**

The purpose of a mock recall is to:

- Ensure the ability to identify and trace raw materials, i.e. seed, and finished product (sprouts) to the first point of distribution.
- Develop a plan for retrieving product from the marketplace (customer).

Periodic mock recalls assess the readiness of the recall team by testing the capability of rapidly identifying and removing products from the market. By testing written recall procedures, any gaps in reliability and accuracy of records, tracing and trace-back systems, response time, contact lists or other problems can be identified and the necessary adjustments made before a real recall takes place.

Mock recalls should be planned, periodic, unannounced and deal with recalling a specific product. They should be conducted at least once a year or when there have been changes to the operation or personnel.

The CFIA's *Testing Your Recall Plan* may be accessed on the CFIA website at:
www.inspection.gc.ca/english/fssa/recarapp/rap/mgguide.shtml.
To test your recall plan, randomly pick a lot code number of sprouts that you know has reached retail consumers. Test various scenarios (e.g., finished product) and ingredients (e.g., seed). For example:

**Scenario 1:** "Our seed supplier just called to say that *Salmonella* has just been discovered on its seed with lot code number H1003. All sprouts grown from that seed must be identified within two hours." In this scenario, the sprouter must **trace forward** from that seed lot and identify the lot codes of all sprouts grown from that particular seed.

**Scenario 2:** "Our complaint department has received three calls from consumers who claim they have become ill from eating sprouts from lot number SH1003B080904. Our in-house investigation indicates that our sprouts are the most probable cause of these people becoming ill. Notices to remove this lot of sprouts from the market must be ready within two hours." In this scenario, the sprouter must identify every retailer and wholesaler that received sprouts from that lot. This is called a **trace-back**.

As the mock recall is being conducted, problems and successes should be documented, as should the date of the test. Details and results of mock recalls should be kept on file. An example of a mock recall form is provided on the next page. Solutions that are developed to correct the identified problems should be included in a revised recall plan. Revisions should also be noted in the mock recall report.

| MOCK RECALL FORM—Finished Product | MOCK RECALL FORM—Ingredients |
|---|---|
| **Date:**<br>**Time Started** 9:00 am **Time Finished** 10:35 am<br>Target: Complete the traceability exercise in two hours | **Date: Time Started Time Finished**<br>Target: Complete the traceability exercise in two hours |
| **Description of Product:** Pea sprouts | **Description of Ingredient:** alfalfa seed |
| **Date or Lot Code:** XZ345 | **Date or Lot Code:** 456DJU |
| **Personnel Involved in Mock Recall:** | **Personnel Involved in Mock Recall:** |
| **RECORDS** (Check when attached):<br>_____ Production Records<br>_____ Distribution Records<br>_____ Discarded Material Record<br>_____ Rework Records (if applicable) | **RECORDS** (Check when attached):<br>_____ Receiving Records<br>_____ Production Records<br>_____ Discarded Material Record |
| **A Quantity of Product on Hand** (verified): 95 boxes<br>**B Quantity of Product Shipped** (first point identified): 500 boxes<br>**C Quantity of Product Discarded** (production loss/spillage or damage): | **A Quantity of Product on Hand** (verified): 498 bags<br>**B Quantity of Product Used** (first point identified): 1 bag<br>**C Quantity of Product Discarded** (production loss/spillage or damage): 1 |
| **A + B + C = Total Quantity Accounted For:** 595 boxes **D** | **A + B + C = Total Quantity Accounted For:** 500 boxes **D** |
| **Total Quantity of Suspect Product Produced:** 600 **E** | **Total Quantity of Suspect Ingredient Received:** 500 bags**E** |
| **D** Total Quantity Accounted For<br>divided by<br>**E** Total Quantity of Suspect Product Produced = %Recovered<br>**= 99.2% Recovered**<br>Trace all finished product to within 2% of the actual quantity | **D** Total Quantity Accounted For<br>divided by<br>**E** Total Quantity of Suspect Product Produced = % Recovered<br>**= 100% Recovered**<br>Trace all ingredients to within 2% of the actual quantity |

| |
|---|
| **IF THIS WERE AN ACTUAL RECALL, the following contacts would be made:**<br>**Regulatory Agency Name/Number** (if applicable)<br>**Supplier Name/Phone and Fax Number** (if applicable)<br>**Customer(s) Name/Phone and Fax Number** (if applicable) |
| **Review of Mock Recall—Signature:** |
| **Comments:** |

## O7 WATER SAFETY

### O7.1 Water Treatment Monitoring

**To prevent or minimize sprout contamination, you should meet this requirement:**

- Water treatment activities are performed in a way that protects the safety and suitability of food.

**This is how to meet the requirement:**

Water quality is essential for the safe production and packing of safe sprouts.

Potential water (and ice) contaminants may be microbial, chemical, or physical. While all may cause adverse health effects, microbial contamination is generally of greatest concern.

**Microbial**

Water may contain enteric pathogens (bacteria, viruses and parasites) that can be transmitted to humans. Although bacteria do not multiply in pure water, many can multiply in food. Viruses and parasites do not reproduce in food but can remain viable (alive) for a period of time.

**Waterborne Pathogens**

| | |
|---|---|
| **Bacteria** | *Salmonella*, *Shigella*, pathogenic strains of *E. coli* (e.g., O157:H7), *Vibrio*, *Heliobacter*, *Yersinia*, *Campylobacter* |
| **Viruses** | Noroviruses, Enteroviruses, Hepatitis A, Rotavirus |
| **Parasites** | *Giardia*, *Crytosporidium*, *Cyclospora*, Amoeba, Toxoplasma, Roundworms, Flatworms, Tapeworms |

Although microbial testing can detect pathogenic bacteria, viruses and protozoa (parasites), it is not practical or economical to routinely test for all of them. Instead, water (and ice) is examined for groups or species of non-pathogenic, fecal bacteria that are usually present in higher numbers than the pathogens.

**Bacterial Indicators**

Coliforms are a group of bacteria that live in the intestinal tract of warm-blooded vertebrates and throughout the environment. They include bacteria such as *Escherichia*, *Klebsiella*, *Enterobacter* and *Citrobacter*, which are found in human and animal fecal material, soil, untreated environmental waters (rivers, ponds, lakes, etc.) and insects. Coliforms are used to indicate the level of hygiene. However, coliform counts are unable to differentiate between fecal and non-fecal contamination.

The presence of coliforms is assumed to result from contamination with fecal material and is used as an indicator of the **possible presence** of enteric (intestinal) pathogens. The absence of coliforms means that pathogenic enteric bacteria are **probably absent**. Coliform bacteria are "indicators of enteric pathogens" or simply "indicators."

*Escherichia coli (E. coli)* are the only coliform species found exclusively in the intestinal tract of humans and other warm-blooded animals. Animals, including humans, shed *E. coli* through their normal digestive process. There are many serotypes (strains) of *E. coli*. Most are harmless. However, a few are pathogenic, so the presence of any *E. coli* in water is cause for concern. The *E. coli* serotype 0157:H7 is a well known and dangerous pathogen.

*E. coli* is the most specific indicator of fecal contamination and the **possible presence** of pathogenic microorganisms in water. If *E. coli* is absent, pathogenic bacteria are **probably** absent. Sources of *E. coli* contamination in water include feedlots, faulty septic systems, barnyards, pastures, rangeland, manure storage facilities and waste lagoons, faulty wastewater treatment plants, wildlife and waterfowl. *Salmonella* can also be found naturally in animals, especially poultry and swine.

There are those who believe that coliforms and *E. coli* are poor indicators of contamination. As a result, new methods are being developed, including heterotrophic plate count (HPC) or total plate count (TPC), which estimates the number of live heterotrophic bacteria (those requiring organic carbon for growth) in water. In conjunction with other testing, HPCs may be useful in identifying the number and spectrum of waterborne bacteria.

None of these traditional bacterial indicators reliably indicate the presence of protozoa (parasites) or viruses.

**Sampling**

When sampling, it should be remembered that water contamination is often intermittent and pathogens do not always distribute uniformly in water. For this reason, a negative test result does not guarantee the absence of pathogenic bacteria. Frequent testing increases the opportunity to discover contamination, if it is present.

While regular testing of municipal water may appear to be unnecessary, the outbreak at Walkerton proved that municipal water is not always safe. Also, safe water that leaves the treatment plant can become contaminated by the distribution/storage system.

For private wells, samples should be collected at times when contamination risk is highest—during spring thaw, after heavy rains, or during dry periods. Surface water is more likely to be contaminated than ground water. However, improper care of drilled or dug wells can result in bacterial and/or chemical contamination of wells. The Ontario Ministry of the Environment has published the following series of Fact Sheets:

- Important Facts About Water Well Construction
  www.ene.gov.on.ca/cons/3788e01.pdf
- The Protection of Water Quality in Drilled Wells
  www.ene.gov.on.ca/cons/3961e01.pdf
- The Protection of Water Quality in Bored and Dug Wells
  www.ene.gov.on.ca/cons/3962e01.pdf
- The Protection of Water Quality in Jetted or Driven Point Wells
  www.ene.gov.on.ca/cons/4505e.pdf
- Managing Your Water Well in Times of Water Shortage
  www.ene.gov.on.ca/cons/3784e.pdf

The CFIA recommends that municipal water used in sprout processing be tested twice a year. Water from other sources (e.g., wells) should be tested once a month. If there are concerns, such as flooding, or the presence of coliform or *E. coli*, the water should be checked more often.

Because contaminated water can cause severe consequences, some food production facilities test much more frequently; some as often as every day. Private laboratories perform coliform and *E. coli* water analysis for a fee in the range of $25 to $30 each. In addition to bacteria, food producers may also wish to test water for metals, minerals and pesticides.

For rural homeowners, water testing is free. Public Health Unit locations and telephone numbers are listed on the Ministry of Health and Long-Term Care Web site at:
www.health.gov.on.ca/english/public/contact/phu/phuloc_dt.html.

All water test reports should be retained for at least one year.

Water samples must be collected in sterile bottles (usually provided by the testing laboratory). Taps or hoses should be allowed to run for at least three minutes before water is collected. Great care should be taken that only water
touches the mouth and inside of the collection bottle. A minimum of 100 mm is required for sampling; however, 500 mm should be collected. All necessary information must be attached to the sample.

Sometimes the size of the sample is doubled. Half of the sample is sent for testing and the other half is retained by the sampler for future testing if the first sample tests positive. (See the next section for an explanation.)

Samples should be transported to the laboratory as quickly as possible, preferably in a cooler. No more than 24 hours should elapse between the time of collection and the time testing begins.

**SOP**

Water sampling procedures should be included in a written Standard Operating Procedure (SOP).

A Water Testing Record should be developed.
See Record 8 in Section 5 Records for an example.

**Interpreting Microbial Test Results**

Microbial test results for water samples indicate:

- The number of colony-forming units per 100 ml (CFU/100 ml) of "total coliform"
- The cfu/100 ml of *E. coli*.

**The maximum acceptable concentration of both coliforms and enteric *E. coli* in water to be used for food production is zero.** If either is detected, immediate resampling should be undertaken. Should food production be allowed to continue, all product should be held until laboratory analysis confirms that the water is safe. If product is shipped and the water is found to be unsafe, a recall of contaminated product may be necessary. If *E. coli* is confirmed, the appropriate agencies (your Public Health Unit) should be notified, the water boiled before use and an investigation undertaken. If consecutive samples determine the presence of coliforms, corrective water treatment should be taken immediately.

Different laboratories have different ways of expressing the number of organisms (coliform or *E. coli)*. Some labs report an absolute number (e.g., 150). Some labs may head their columns "cfu/100 ml" (colony-forming units per 100 ml). In reality, the number reported is really still the number of organisms, albeit expressed in a very confusing manner. For example, the reported number of coliforms may be 1.50E + 02. The "E" means exponent (to the power of 10). Therefore the number converts to $1.50 \times 10^2$ or $1.50 \times 10 \times 10$, which equals 150. There are 150 coliforms in 100 millilitres of water.

Other examples: $<1.0E+00 = <1.0 \times 10^0 = <1.0 \times 1 = <1$ organism
$8.5E + 01 = 8.5 \times 10^1 = 8.5 \times 10 = 85$ organisms
$2.0E + 03 = 2.0 \times 10^3 = 2.0 \times 10 \times 10 \times 10 = 2{,}000$ organisms

Test results should be interpreted with caution.

When test results are negative, the results are assumed to be correct. However, **negative test results DO NOT GUARANTEE the absence of pathogens in the water.** Pathogens may be present; they just were not found because they are present in low numbers and not uniformly distributed.

When the water tests positive, the results are also presumed to be correct (a presumptive positive). At this point, there are two options.

Option 1: Agree that the test result is correct and take immediate corrective action.

Option 2: Test the duplicate sample (described above) to confirm that the first result was correct.

The prudent choice is to accept the initial result rather than trying to prove it incorrect.

Keep copies of all sample results. A water testing record will assist in monitoring results and indicate when additional sampling should take place.

**Chemicals**

Chemicals, such as pesticides, synthetic organics, nitrates, arsenic, lead, mercury, and asbestos are sometimes found in water. In large enough quantities all are potentially toxic. Chemical contamination can result from chemical spills, incorrect use of pesticides, improper water treatment, or cross-contamination from sewage or industrial waste.

**Physical**

Physical characteristics of water include colour, odour, taste, temperature and turbidity (cloudiness). These characteristics are primarily aesthetic and generally pose very small health risks, but may affect food quality and the effectiveness of cleaning and sanitizing chemicals.

**Water Standards**

Water quality is a very important element in food safety. All water used in sprout production and cleaning activities must be potable (must meet Ontario Drinking Water Quality Standards, O. Reg. 169/03, under the Safe Drinking Water Act, 2002, which is available at: www.e-laws.gov.on.ca/DBLaws/Statutes/English/02s32_e.htm).

**Water Treatment Plan**

Water testing results may indicate that a water treatment program is required. A water treatment program should include the following elements:

- The water treatment activity to be performed (e.g., UV treatment of well water, wash water chlorination, filtering/treatment of recycled wash water or flume water)
- The personnel responsible for each of the treatment activities
- The chemicals/equipment required for each treatment
- Explicit directions as to how to use the required equipment, including filter, screen, etc., as well as cleaning and maintenance; and for chemicals, explicit directions as to proper handling of the chemicals (for personal safety and to prevent or minimize contamination), including the concentration to be used
- The criteria/schedule for water treatment activities
- The documentation required.

**SOP**

When water treatment is required, the procedures to follow should be recorded in a written Standard Operating Procedure (SOP).

**Water Treatment Options**

An ideal system purifies water to the quality level required for its intended use and, where necessary, provides ongoing residual disinfection after treatment but does not cause chemical contamination of the water. The selection of a system or combination of systems (the multibarrier approach) should be based on the contaminants to be removed, the amount of water used, the initial cost, and ongoing costs of operating and maintaining the system. *A Procedure for Disinfection of Drinking Water in Ontario* may be found at: www.ene.gov.on.ca/envision/gp/4448e01.pdf.

*Chlorine*

Chlorination is the most common method of eliminating disease-causing organisms in water. The effectiveness of chlorine depends on several factors:

- The chlorine demand of the water (e.g., turbidity, organic matter, presence of chemicals such as iron, manganese, hydrogen sulfide, and ammonia)
- The concentration of the chlorine solution added

- The time that chlorine is in contact with the organism
- The water temperature
- Water pH.

When chlorine is added to water, a portion of it combines with other dissolved chemicals and plant material in the water and is "used up." Only the remaining chlorine (commonly referred to as "free chlorine," *mainly hypochlorous acid) is* available to destroy pathogenic microorganisms present in the water. Easy-to-use test kits can be used to measure chlorine residual levels. Frequent testing (every one to two hours) will ensure that chlorine concentration is maintained at proper levels.

The water pH level greatly influences the chlorine concentration required for effective disinfection. The "free chlorine" (hypochlorous acid) in solution decreases as pH increases and increases as pH decreases. However, if the pH falls below 4.0, dangerous chlorine gas is produced. The optimum pH for the presence of hypochlorous acid is 6.5 to 7.0. Water pH should be checked when chlorine is added. Although seldom necessary, the pH may be adjusted with commercially available buffers, if necessary.

Temperature also affects chlorine effectiveness. Reaction rates double for every 10°C increase in temperature, up to 52°C. However, chlorine is relatively ineffective at temperatures above 46°C. At higher temperatures, dangerous chlorine gas is released.

When chlorine is added to water containing high organic matter content, a group of byproducts known as trihalomethanes (THMs) may be formed. Although risks from these byproducts are apparently small, their presence can be controlled by filtering out natural organic material in the water prior to disinfection.

Depending upon the system, either liquid or dry chlorine may be used as a disinfectant. A number of devices may be used to meter chlorine into the system continuously, or chlorine may be added to water held in tanks before use (simple chlorination). Short contact time is available at high chlorine concentrations (10 ppm) and is called superchlorination. It may produce undesirable strong odours. If necessary, these odours can be removed with a carbon filter just before the water is used.

*Cryptosporidium parvum* and *Giardia lamblia* are sometimes present in water. Both are resistant to chlorination. They may be removed by filtration in commercial water treatment facilities but not by filters generally found in small sprout production facilities. Recent scientific studies using ultraviolet radiation and ozone treatment show promise.

*Hydrogen Peroxide*

Hydrogen peroxide is a powerful anti-oxidant. However, when compared to chlorine, hydrogen peroxide ($H_2O_2$) is a much less effective disinfectant. It has not been approved as a stand-alone microbial treatment in potable water systems. Hydrogen peroxide is mostly used in combination with other disinfection/sanitation methods to increase its effectiveness. By itself and in combination, hydrogen peroxide is often used for treatment of air, non-potable water, wastewater, soil and sludge.

Hydrogen peroxide is environmentally friendly, decomposing into water and oxygen.

*Other Chemicals*

Alternatives to chlorine-based disinfectants in drinking water exist. However, some are of questionable value and others create undesirable byproducts in the water.

All water bacterial treatment chemicals considered for use must be included in the *Reference Listing of Accepted Construction Materials, Packaging Materials and Non-Food Chemical Products* from the CFIA at: www.inspection.gc.ca/english/fssa/reference/refere.shtml.

*Filters*

The size of the openings in filters is measured in microns. One million microns equals one metre. A human hair is about 100 microns in diameter. A rod-shaped *E. coli* bacterium is 1.0 to 1.5 microns in diameter and 2 to 6 microns long. A *Salmonella typhi* bacteria, which is also rod shaped, is 0.4 to 0.6 microns in diameter and 2 to 3 microns in length. Round *Cryptosporidium* cysts (a parasite) are 4 to 6 microns in diameter. A virus can be .02 to 0.25 microns in size.

There are two common types of filters, sediment (made of fibres or ceramic) and activated carbon. Sometimes the two types are combined into one unit. Filtration efficiency is classified as either "absolute" or "nominal." An *Absolute Filter Rating* means that 99.9 per cent of the particles larger than a specified micron rating will be trapped on or within the filter. A *Nominal Filter Rating* indicates that the filter will retain 85 per cent of the particles of the size equal to the nominal filter rating.

Fine pore sediment filters (1 micron or smaller) will remove *Cryptosporidium* cysts and some bacteria, as well as physical particles. No filter will remove dissolved lead, mercury, trihalomethanes, or other organic compounds. Viruses cannot be removed by any filtration method. The finer the filter pore, the more it traps, but the flow rate is proportionally slower and the filter should be changed more often.

Carbon is a powerful absorbent. Activated carbon filters consist of carbon particles that have been heat-treated to increase their surface area. One gram of activated carbon has a surface area of 600 to 1,000 square metres and can adsorb thousands of different chemicals.

Solid Block Activated Carbon (SBAC) filters have compressed carbon granules with an effective pore size of 0.5 to 1 micron. They are very effective in removing bacteria, chemicals and particulate material by mechanical straining and chemical bonding (adsorption). Granular Activated Carbon (GAC) filters have fairly large carbon granules and relatively large (20–30 microns) pores so straining and adsorption of impurities and bacteria may not be complete. It should be remembered that the capacity of carbon to adsorb contaminants is finite. Once the carbon surface is covered, its adsorption capacity is exhausted and the carbon (or entire filter) should be replaced.

*Ultraviolet (UV) Light*

Water passes through a clear chamber where it is exposed to ultraviolet light generated by mercury arc lamps. It is a non-chemical disinfectant.

UV radiation kills bacteria, most viruses (not retroviruses and rotaviruses), spores, and cysts (*Cryptosporidium*) by penetrating cell walls and damaging genetic material. It has no effect on lead, asbestos, organic chemicals or chlorine. Cloudy or turbid water reduces UV effectiveness. UV radiation has no residual disinfection effect but forms no known byproducts at levels of concern.

High capital costs and high maintenance costs are generally associated with UV equipment. Water clarity, hard water scaling on UV tubes and biological fouling of the UV tube can compromise disinfecting action. UV lights should be used only in covered in-line applications. Eye exposure to UV radiation can cause permanent eye damage.

*Ozonation*

An ozone molecule contains three oxygen atoms ($O_3$) instead of the two atoms ($O_2$) found in a normal oxygen molecule. Ozone occurs naturally through lightening and when ultraviolet rays of the sun react with the

Earth's upper atmosphere. It may be generated on-site in several ways including by passing dry oxygen or air through a system of high-voltage electrodes.

Ozone is a powerful oxidant and sanitizer. It kills bacteria, parasites, and mould and yeast spores by oxidation. It is an excellent virucide. Its high reactivity and low solubility make it difficult to apply and control.

While ozonation produces no chlorinated byproducts (THMs), it does form brominated byproducts (bromate, brominated organics) and nonhalogenated byproducts (ketenes, organic acids, aldehydes). Ozone breaks down complex organic matter into small compounds that increase nutrients in water supplies and enhance microbial regrowth in water distribution systems. It provides no residual disinfection.

While ozonation has been successfully used, ozone generators are costly, complicated, and require a high level of technical competence to operate and maintain. However, new technology improvements show promise in both water sanitation and direct food contact applications.

**Dehulling Water**

Wash water purification/disinfection is a unique challenge due to the heavy organic/soil load often carried by the water. Contrary to popular belief, chlorine in wash water is not intended to sanitize individual sprouts. Instead, chlorine (or any other wash water disinfectant) kills pathogens washed off the sprouts. This prevents the wash water from becoming a reservoir of pathogens that can contaminate previously uncontaminated sprouts.

Chlorine is a powerful oxidant but does not discriminate what it reacts with, so the higher the level organic matter/soil in the wash water, the higher the level of reaction, and the faster the chlorine is "used up" and loses its effectiveness. Filtering water to remove debris and/or changing water often is the most effective way to maintain water cleanliness and sanitation efficacy.

Once organic matter and turbidity have been filtered from the wash water, chlorine can be added with some assurance that it will be effective as a sanitizer. As noted earlier in this section, water pH, water temperature, chlorine concentration level and contact time also affect chlorine performance.

To maintain proper chlorine levels, a regular monitoring schedule is necessary for both chlorine and pH. Chemically impregnated paper strips may be used for both. Chlorine is most effective at a pH between 6.5 and 7.0. Chlorine may be added to post-harvest wash water to a maximum concentration of 200 ppm. Sodium hypochlorite is the recommended source of chlorine. Scented household bleach should not be used. The formula for calculating the correct amount of chlorine to add to potable water can be found in O3 Sanitation- Chorine, in section 4, Operational controls. Improperly handled chlorine can be dangerous. Always follow the manufacturer's directions during its preparation.

Recycled/recirculated dehulling water should be confined to a clearly identified, separate system. This permits the water to be monitored so that it can be filtered/treated to the appropriate level. Dehulling water systems should be cleaned and sanitized periodically so they do not become a source of contamination.

Only chemicals included in the Water Treatment Compounds section of the CFIA's *Reference Listing of Accepted Construction Materials, Packaging Materials and Non-Food Chemical Products* at www.inspection.gc.ca/english/fssa/reference/refere.shtml should be used for water treatment. Note that there is a subsection listing acceptable chemicals that "may come in contact with food products" and another for chemicals that "will not come in contact with food products."

**Stored Water**

When water is stored, the storage container should meet all criteria outlined in the CFIA's *Reference Listing of Accepted Construction Materials, Packaging Materials and Non-Food Chemical Products,* which may be accessed at: www.inspection.gc.ca/english/fssa/reference/refere.shtml. The container should be covered.

As with water recycling systems, water storage containers should also be cleaned and sanitized periodically so they do not become a source of contamination.

As with all other activities in the food production environment, adequate training should be provided to those performing these activities.

## O7.2 Water Safety Monitoring

**To prevent or minimize sprout contamination, you should meet this requirement:**

- Water safety monitoring activities are performed in a way that protects the safety and suitability of food.

**This is how to meet the requirement:**

To ensure that the water treatment plan is being implemented and to monitor its effectiveness in maintaining potable water, a water monitoring plan is also necessary.

A water monitoring plan should include the following:

- A list of the water samples to be collected and the schedule for collecting them. Some samples may be for in-house testing (e.g., chlorine levels in wash water) and some may be tested externally (e.g., for fecal coliforms).
- A detailed description of the water sample collection and sample submission procedures. If testing is done in-house, the testing procedures should also be described, including the equipment and chemicals to be used.
- The personnel responsible for each task.
- Documentation requirements for each sample (e.g., date of sampling, water source, sample site, analytical result, analyst (in-house person or external accredited laboratory).
- The actions to be taken when the water analysis does not meet predetermined criteria (e.g., add more chlorine, shut down the production line if *E. coli* O157:H7 is discovered, recall product, etc.)

A monitoring plan is not a static document. It should be reviewed for completeness, accuracy and suitability to changing circumstances within the sprout facility.

**Contingency Plan**

Every sprout producer should have a contingency plan in place to deal with unsatisfactory water. That plan may include on-site treatment, trucking in water of satisfactory quality, or, if necessary, ceasing operations until the water quality returns to acceptable standards.

**SOP**

Each of these requirements that is appropriate to your operation should be included in a written Standard Operating Procedure (SOP).

## O8 TRACEABILITY (section 10 in *HACCP Advantage Plus+*)

**What Is Traceability?**

"Traceability is the ability to trace the history, application or location of an entity by means of recorded information" (as defined in the *Federal-Provincial-Territorial Framework Agreement on Agricultural and Agri-Food Policy for the Twenty First Century,* available at: www.agr.gc.ca/cb/apf/index_e.php?section=info&group=accord&page=accord5.

A traceability program describes the roles, responsibilities and instructions that apply to the appropriate gathering, storage and communication of traceability information. Traceability information includes supplier and customer information and identification of products, components or ingredients (including packaging) that may have an impact on food safety. The traceability program allows the packaged sprouts to be traced *back* to their raw materials/ingredients or traced *forward* to the customer.

**Trace Forward** →

Supplier (seed, packaging) | Sprouts (finished product) | Transporter | Point of Sale

**Trace Back** ←

In short, an effective traceability program provides the tools to protect the public through the effective recall or withdrawal of problem products from the market. A traceability system can substantially reduce the cost of a recall by enabling only affected product to be withdrawn from the market.

Traceability can be used by a sprout producer:

- To track the location of a specific lot of unsafe sprouts in order to quickly and efficiently remove them from the marketplace. The traceability system should link the incoming sprout seeds with the outgoing sprouts through all stages of the supply chain, including retail, etc.
- To investigate the cause of sprout safety and/or quality problems of a specific product code or lot (or lots) of sprouts (e.g., seed, improper production practices, contaminated packaging, improper cold chain management, etc.). Additional information on product coding can be found in Section O6.

The bigger the production volume of sprouts and/or the larger the number of accounts serviced, the greater the need for documented traceability information.

## O8.1 Incoming Materials

**To ensure traceability of seeds and packaging you should meet these requirements:**

- Traceability information for all incoming food, ingredients, packaging materials and returned products is recorded accurately and efficiently whenever products or materials are received into the facility
- Incoming food, ingredients and packaging materials, and their point of origin, are adequately identified when entering the facility.

**This is how to meet these requirements:**

Incoming materials include the seed, packaging and returned products (packaged sprouts). Ensure that all key supplier information is documented for all incoming materials. Supplier information may include name of the supplier, name of the contact person, address, telephone, fax number and e-mail address.

**Traceability Records**
***Incoming Seed***
***Packaging Materials***
***Finished Product Returns***

An effective traceability program for incoming materials includes a system that records identification information for all incoming materials. The traceability system requires written records. To be effective, traceability records should provide enough information to allow a sprout grower to:

- Link **incoming materials**, e.g., seed lot number, packaging lot number) to **suppliers**
- Link **incoming materials**, e.g., seed lot number, to **packaged** *sprout* codes (code packaged sprouts by lot number)

The incoming materials records for seeds and packaging should document:

- Date received
- Supplier name
- Name of Product Received
- Quality received
- Invoice or Reference Number
- Lot number
- The transporter (carrier) who delivered the materials
- Seal Number (if applicable)

- Are seals intact with no evidence of tampering? ☐ NO ☐ YES
  If no, notify appropriate management immediately.
- Temperature (if applicable)
- Any damage to material etc. and action taken
- Storage Location (if applicable)
- Corrective Action Taken
- Initials of person who received the incoming material.
- Comments section, for example note any concerns (e.g., mouse dropping found on some bags of seed, off-odours detected in carrier etc.).

If lot numbers for the incoming product are missing, specify a new traceability identifier (lot number) and link it to the shipment records at the point of receiving. The supplier should be notified of this missing information. Mixing of multiple lots can complicate trace-back and provide an opportunity for cross-contamination. The supplier should be notified as well.

If returned products (packaged sprouts) are accepted at the sprouting facility the following information should be documented:

- Date product was returned
- Name of customer that returned the product
- Description of product
- Amount of product returned
- Lot number
- The reason for the returned product
- Name of person who received the returned product
- What was done with the returned product (e.g., dumped in garbage).
- Name of person who destroyed the product
- Comments section.

Returned sprouts products should be clearly identified and stored in a controlled area clearly isolated from "good" product.

The incoming materials record should be easily accessible and used at the point of receiving. Only trained receiving personnel should record traceability information.

**SOP** Traceability procedures appropriate to your facility should be included in a written Standard Operating Procedure (SOP).

The following are suggested, as the *minimal* records required to facilitate a recall:

- An Ingredient and Packaging Receiving Record. See Record 1in Section 5 Records for an example.
- A Sprouts Returns Record. See Record 2 in Section 5 Records for an example.
- Contact information for all suppliers.

## O8.2 Outgoing Materials

**To ensure traceability of sprouts you should meet these requirements:**

- Traceability information for finished packaged sprouts is recorded accurately when shipped from the facility.
- Contents of conveyance vehicles are labelled correctly and traceability information recorded when products are shipped.
- Information regarding the destination of shipped products is captured and recorded.

**This is how to meet these requirements:**

An effective traceability program for outgoing materials includes a system that records identification information for all outgoing materials. The traceability system requires written records. To be effective, traceability records should provide enough information to allow a sprout grower to:

- Link **outgoing material**, e.g., sprout lot codes, to **accounts** receiving the sprouts.

Inadequate identification (lot number) on outgoing sprouts or inconsistent recording of traceability information can delay the identification of unsafe product.

If applicable, record traceability information every time a product or container of products is transported to a new location in the cold storage warehouse. This may apply to large sprouters that have a large cold storage facility with a computerized inventory tracking system.

**Traceability Records Sprouts**

The outgoing material records should be product and lot code specific. They should document:

- Date the sprouts were shipped
- The product name
- Lot code
- Quantity shipped to each account

- The transporter (carrier)
- Who received the sprouts (customer)
- Record completed by (name or initials)
- Comments section.

A copy of the customer invoice containing the above information can be used as a record of outgoing materials.

Distribution information should be up to date, complete and readily available in order to facilitate a successful recall. (For an example see Record 10 in Section 5 Records).

The distribution list should include:

- The name of the account, type of account (e.g., restaurant, distributor, retailer), street address, city and province
- The contact person at the account including his or her telephone number(s), fax number and e-mail address.

In the event of a recall, the distribution list should be provided to the CFIA within 24 hours of the ordered recall. The outgoing material (distribution) records should be kept for a period of time that comfortably exceeds the shelf life of the sprouts shipped (the CFIA suggests one year).

It is not necessary to identify individual retail consumers. If the health consequences of consuming the product are considered serious, a food safety alert will be issued or ordered by the CFIA.

The outgoing traceability records should be easily accessible and only trained shipping personnel should record traceability information.

**SOP** Traceability procedures appropriate to your facility should be included in a written Standard Operating Procedure (SOP).

The following are suggested, as the *minimal* records required to facilitate the recall of sprouts:

- A unique code or lot number that identifies each lot of sprouts to separate it from all other lots of sprouts.
- Quantity of sprouts produced. See Record 7 in Section 5 Records for an example.
- Records of finished goods shipped to customers, distributors etc., See Record 6 in Section 5 Records for an example.
- Contact information for all customers and distributors.

## O9 SECURITY (section O11 in *HACCP Advantage Plus+*)

### Security Background

The security of a sprout processing facility is very important. Deliberate tampering or adulteration of food can have devastating and long-lasting effects not only on the health of consumers but also on the image of the company that produced the implicated food product. Ensuring a secure sprout processing environment is the best defence against this type of problem.

When writing the food security program it is important to understand the similarities and differences between GMPs and food security programs.

***Accidental* Contamination**

GMP programs prevent *accidental* physical, chemical or biological contamination (e.g., metal shavings, cleaning chemicals and *E. coli*) These types of contaminants could enter the product during production, transport or storage.

***Deliberate* Contamination**

Food security programs prevent planned contamination. Each processor should consider the likelihood of a person or persons deliberately contaminating product to cause harm. The size, complexity and vulnerability of our food supply is a growing public concern.

People who purposely contaminate food products are called saboteurs. One aspect of a food security program is to identify possible saboteurs at your facility. It is very important to determine what types of people would want to harm food products so that you can prevent planned product contamination from occurring. Saboteurs include criminals, protestors, terrorists and disgruntled employees.

The written security program should outline effective security policies and procedures to protect food, ingredients and packaging from:

- Tampering
- Theft
- Adulteration
- Intentional contamination.

At a minimum, the program outlines a security plan that includes procedures and policies for:

- Handling threats
- Deliberate product adulteration

- Control and/or disposal of potentially dangerous materials
- Facility security inspection
- Facility evacuation
- Acceptable materials and items allowed within the facility.

The written security program should include procedures that notify the appropriate government authority in the event of deliberate product tampering or adulteration, product theft or threats. A list of current government and law authority contact information should be developed and updated as required.

Form a security team and assign responsibilities within the security plan to individual team members. The size of the team usually depends on the size of the facility and the amount of resources. A successful team usually has five to eight members. A well-developed security team will include members who represent all departments of the facility. Delegate a lead team member as the security coordinator.

The Facility Security Team should include:

- Facility Security Coordinator—Team Leader (name and phone number, responsibilities)
- Facility Manager (name and phone number, responsibilities)
- Human Resources Manager (name and phone number, responsibilities)
- Facility Production Manager (name and phone number, responsibilities)
- Quality Manager (name and phone number, responsibilities)
- Engineer or Maintenance Manager (name and phone number, responsibilities).

The security team should meet frequently to discuss security programs, policies and procedures; review documentation and control measures; and recommend and record changes, if necessary.

Training security team members is vital when establishing a security program. There are several ways to become trained in food security, including:

- Attending off-site or on-line food security courses (e.g., AIB [American Institute of Baking] offers a course in Food Defence. More information can be found at the following link: www.aibfooddefense.org/training.html)
- Hosting an in-house security course

- Working with contracted security professionals
- Gaining security credentials.

## O9.1 Employee Identification and Personnel Control

**To ensure security at your facility, you should meet these requirements:**

- A positive identification system for facility employees is developed, implemented and required for all employees prior to entrance into the facility.
- The system includes an up-to-date list of facility employees, their work area, and their normal working hours. New employees undergo a background check to verify their identification prior to commencing employment.
- Ensure that any personnel entering the facility who are not employees (e.g., visitors, contractors, auditors) are restricted to non-product areas unless accompanied by a facility representative authorized by the security team.

**This is how to meet these requirements:**

A positive identification system for facility employees should be developed, implemented and required for all employees prior to entrance into the facility. An example of an identification system that clearly and uniquely identifies all employees may include picture ID cards or sign-in/sign-out at security or reception. The employee identification system should ensure only authorized employees and cleared visitors are able to gain entry into the facility.

Ensure that an up-to-date employee list is available at the employee entrance and to facility management. If applicable, the list may include employee-assigned work areas and/or hours. Procedures should be established for controlled entry of employees into the facility during both working and non-working hours. If applicable, an identification system that clearly identifies employees to their specific work function or area (e.g., coloured workwear, coloured/numbered card) may be developed.

Ensure that all new hires receive a thorough background check prior to employment to verify their identity and identify any potential employee risk. New hires include seasonal, temporary, permanent and contract workers.

Ensure that any personnel entering the facility who are not named on the employee list (e.g., visitors, contractors, auditors) are restricted to non-product areas unless accompanied by an authorized employee familiar with

the facility and the security plan. A policy should be developed that visitors entering the facility should be required to sign in/sign out. The facility should have a detailed written visitor entry program.
The program should include sign-in, identification, escorts, access, etc. It should specify how visitors are managed from the time they enter the parking lot until they exit the building.

The facility should determine who is considered a visitor. It is recommended that anyone not employed by the company be considered a visitor and be required to obey the visitor policy. This includes outside contracting services, employees' family members, auditors, inspectors, pest control companies, etc. The visitor policy should address how they will be identified. Facilities may use visitor identification badges or colour-coded smocks or hard hats to distinguish visitors.

The facility should develop an acceptable materials policy that includes a list of materials that employees, visitors and contractors are allowed to bring into the facility and within the production area. This should be posted and enforced. For example, there should be a policy allowing only those personal-use medicines that are necessary for the health of staff and ensuring that these personal-use medicines are properly labelled and stored away from food handling or storage areas. Guns and knives should not be allowed on company property.
The written security program should develop procedures that when followed will facilitate an organized, efficient, safe and rapid evacuation of all personnel, visitors and contractors from the facility.

A Visitor Sign-in/Sign-out Record should be developed.
See Record 9 in Section 5 Records for an example.

## O9.2 Access to Sensitive Areas

**To ensure security at your facility, you should meet these requirements:**

- Access to critical or sensitive areas of the facility such as laboratories, chemical and hazardous materials storage areas, interior and exterior food storage areas, wells, water and ice processing equipment, and central controls for airflow, water systems, electricity and gas is restricted and controlled.
- Restricted areas within the facility are secured and clearly marked with appropriate signage.

**This is how to meet these requirements:**

Access to sensitive or critical areas/equipment should be controlled or restricted by use of locking mechanisms or other entry prevention measure.

Areas that should be controlled or secured include:

- Laboratories
- Food, ingredient, chemical and hazardous materials storage areas
- Controls for air flow, water systems, electricity and gas supply
- Exterior trailers, food storage areas, tanks and silos
- Maintenance areas
- Mixing rooms.

The written security program should also describe establishment policies, procedures and controls regarding control or disposal of potentially dangerous materials. These written policies and procedures should include:

- How potentially dangerous materials (reagents, bacterial cultures, etc.) are properly controlled to prevent food contamination
- Disposal procedures for dangerous materials or implicated product.

Restricted areas inside the facility should be secure and be clearly marked with legible signage. Allow only authorized employees or contractors to enter critical or sensitive areas. Restrict access to production and food storage areas only to employees or visitors accompanied by authorized employees.

Some facilities use a colour-coded badge system to identify the facility areas an employee may access. The background colour behind the employee's picture signifies the level of facility access. A colour-code reference sheet should be displayed throughout the facility to serve as a reminder of the background colour permissible for each area.

For example, food plant A has a colour-coded badge system with three levels:

- *Green* signifies employees who have access to all areas.
- *Red* signifies employees who are allowed only in warehouse areas.
- *Blue* signifies employees who are allowed only in production areas.

The written security program should describe establishment policies, procedures and controls regarding facility security inspection. These written policies and procedures should include:

- Verifying the structural and physical security of the facility at a predetermined frequency
- Facility inspections of the building, roofs, parking lots and surrounding areas for evidence of tampering.

A Sign-in/Sign-out Record should be developed.

## O9.3 Control of Incoming and Outgoing Shipments

**To ensure security at your facility, you should meet these requirements:**

- The integrity of incoming and outgoing food, ingredients, packaging materials, returned products and all other deliveries is inspected for evidence of tampering, adulteration or foreign materials.
- Incoming shipments are verified against purchase orders or other incoming shipment documentation.

**This is how to meet these requirements:**

All incoming ingredients, food, packaging materials, construction materials, chemicals, returned product and all other deliveries should be inspected for any evidence of tampering, temperature abuse, lot numbers that do not match the bill of lading, adulteration, theft or other questionable activities. It is important that shipping/receiving employees investigate suspicious shipping records (e.g., strange alterations, additions, deletions, faked records). All employees conducting these inspections should be trained to identify possible issues.

Incoming shipments should be verified against purchase orders or other incoming shipment documentation.

Request, where possible, that incoming shipments from food and materials suppliers are sealed with tamper-proof, numbered seals or tags that can be

verified for accuracy. For example, sprouters should require that trucks delivering seed be sealed. All trailers on the premises should be locked and sealed when not being loaded or unloaded. All outgoing shipments should be sealed with tamper-proof, numbered seals that are included on the shipping documents.

Receiving personnel should be notified of all incoming shipments prior to their arrival. Written notifications can be used to verify the contents and accuracy of each incoming shipment. Ensure that any shipment that arrives without notification is properly verified and inspected prior to unloading into the facility.

A policy for off-hour deliveries should be established to both ensure prior notice of such deliveries and require the presence of an authorized individual to verify and receive the shipment.

Where appropriate, consider suppliers' food security programs when selecting suppliers of all food, ingredients, packaging materials, chemicals and other materials.

## O9.4 Inventory Control

**To ensure security at your facility, you should meet these requirements:**

- Inventory within the facility is strictly controlled and tracked for ingredients, packaging materials, processing aids, finished products and all hazardous materials.
- Inventory is organized in a manner that allows timely identification, segregation and security of all products involved in the event of product tampering or adulteration.
- An accurate inventory is maintained continually through usage recording, inspection and verification to allow the detection of unexplained additions or withdrawals from existing stock.

**This is how to meet these requirements:**

Organize all inventory, including all ingredients, packaging materials and finished products, so that any product or material implicated or involved in suspected tampering, adulteration or contamination can be quickly identified and segregated.
An accurate inventory is maintained continually through usage recording, inspection and verification to allow the detection of unexplained additions or withdrawals from existing stock.

Employees should record:

- All incoming materials so that they can be added to inventory
- All use of seeds and packaging materials so that they can be subtracted from inventory and compared against projected usage.

At a predetermined frequency (e.g., monthly), perform a physical count of all products within the facility and compare to inventory records. Separate any products with discrepancies and begin corrective action. Conduct a daily inventory of hazardous chemicals or related items so discrepancies can be identified quickly.

The written security program should also describe establishment policies, procedures and controls regarding handling of threats, tampering or product adulteration.
These written policies and procedures should include:

- How potentially implicated product is identified, located and secured.
- Procedures that outline measures to verify product safety before release.
- How personnel advise management when these events occur.

Develop a relationship with a testing laboratory for possible assistance in the investigation of tampering or adulteration cases.

## O9.5 Security Inspections

**To ensure security at your facility, you should meet this requirement:**

- The facility perimeter and all points where intentional damage to equipment or the facility would result in a food safety or security hazard are monitored for signs of activity or unauthorized entry at a predetermined frequency.

**This is how to meet the requirement:**

There should be routine security inspections of sensitive equipment and all storage facilities, including any temporary storage vehicles, for any signs of tampering, theft or abuse.

The facility perimeter and all points where intentional damage to equipment or the facility would result in a food safety or security hazard are monitored for signs of suspicious activity or unauthorized entry at a predetermined frequency.

Uunusual or suspicious behaviour by staff may include staff who, without an identifiable purpose, stay unusually late after the end of their shift, arrive unusually early, access files/information/areas of the facility outside the areas of their responsibility, remove documents from the facility, ask questions on sensitive subjects, or bring cameras to work.

Inspect potable and non-potable water lines in sprout processing areas periodically for possible tampering. All central controls for ventilation, gas, electricity and water control/heating should be inspected for signs of possible tampering as well.

At a predetermined frequency, ensure that all cameras, locks and other security measures are functioning as intended. If applicable, consider putting in place procedures to monitor the operation of sensitive pieces of equipment to prevent product or equipment tampering.

The written security program should describe establishment policies, procedures and controls regarding facility security inspection.

These written policies and procedures should include:

- Verifying the structural and physical security of the facility at a predetermined frequency
- Facility inspections of the building, roofs, parking lots and surrounding areas for evidence of tampering.

**SOP** Each of these security measures (Sections O9.1–O9.5) appropriate to your operation should be included in a written Standard Operating Procedure (SOP).

**Additional information may be accessed at the following links:**

**USDA** (U.S. Department of Agriculture) FSIS (Food Safety and Inspection Service) *Security Guidelines for Food Processors.*
www.fsis.usda.gov/OA/topics/SecurityGuide.pdf

**USDA FSIS**
*Industry Self-Assessment Checklist for Food Security*
www.aamp.com/foodsafety/SelfAssessmentChecklistFoodSecurity.pdf.pdf

**U.S. Food and Drug Administration**
Guidance for Industry: *Food Producers, Processors, and Transporters: Food Security Preventive Measures Guidance*
www.cfsan.fda.gov/~dms/secguid6.html

Information on the ***AIB Guide to Food Security*** can be found at:
https://secure.aibonline.org/php/ecomm-catalog.php?catalogNbr=06-1460&site=0.

# RECORDS

**Due Diligence** Records offer written proof that GMPs are being followed and those operational processes are under control, thus reducing the probability of contamination. They are your "due diligence." Records also create an investigative mechanism to determine the cause (e.g., the program has not been followed) or to rule out the cause (e.g., the program has been followed) of sprout safety or quality problems, should they occur.

**Records** Comprehensive records require close monitoring of the various production practices within the facility. Examination, analysis and use of these findings often lead to an added benefit of greater production efficiencies.

As a rule, good records are simple, accurate, timely, consistent, understandable, reliable and complete. They should accurately reflect what took place, indicate the results and document any corrective actions.

Sprouters may design their own records based on their needs and the criteria listed above. Related information may be combined into a single form. Where possible, create records that offer a check box to confirm satisfactory conditions or completion of procedures; these are much more likely to be completed than record forms that require a large amount of writing.

Organize the required records in a binder, covered clipboard or file that is clearly marked and readily accessible. Attach a pen to the binder or clipboard. As the event takes place, record the required data immediately. That way, individuals don't need to try to remember what happened. Once the record has been completed, file it in an organized way in an accessible location. Large sprouters may consider using computerized record-keeping systems.

Records should be kept easily accessible for at least one year for each batch of sprouts. This will ensure their availability if needed for a food safety investigation.

Records should be:

- Legible
- Permanent (use a pen, do not use correction fluid to make corrections— cross out changes and initial correction)
- Accurate
- Signed and dated by individual(s) responsible.

Records must include:

- A unique code or lot number that identifies each lot of sprouts to separate it from all other lots of sprouts
- Records of finished goods shipped to customers, including dates, descriptions of package sizes and quantities
- Contact information for all customers
- Facility and equipment cleaning/sanitation records
- Equipment maintenance and calibration records
- Pest control records
- Waste management records
- Water analysis records
- Employee training and training acknowledgment records
- Supply receiving records—sales invoice, bill of lading or purchase order is acceptable to establish a link between incoming and outgoing lots (e.g., purchase receipts for seed, packaging materials, cleaners and sanitizers, and seeds and water disinfection chemicals)
- Inventory management records (to ensure First In, First Out rotation of seed, sprouts and other supplies)
- Supplier-provided seed safety certificates or certificate of analysis (a document indicating that the seed has been sampled, inspected, sprouted and tested for pathogens)—an example of such a certificate may be found at: ww.sproutnet.com/seed_certificate.htm.
- Internal seed sampling, inspection and pathogen-testing records
- Seed disinfection records
- Sprout growing log (e.g., room number, date started, number of trays/bins, tray/bin numbers, watering frequency, room temperatures, nutrients added, unusual events, etc.)
- Spent irrigation water pathogen analysis
- Harvesting/packing log (e.g., date of harvest, size and number of packages, lot codes)
- Dehulling tank chlorination records
- A cooler temperature log
- Transportation records including the name of the carrier, the hygienic condition and temperature of the carrier, etc.
- Records of returned product and their disposition

- A customer complaints file to identify safety and quality issues while they are still manageable
- Corrective action taken
- Supplier agreements etc.

**Types of Records**

This next section lists the types of information that may be included in the record.

### Record 1 - Ingredient and Packaging Receiving Record

- Date received
- Supplier name
- Name of Product Received
- Quality received
- Invoice or Reference Number
- Lot number
- The transporter (carrier) who delivered the materials
- Seal Number (if applicable)
- Are seals intact with no evidence of tampering? □ NO □ YES
  If no, notify appropriate management immediately.
- Temperature (if applicable)
- Any damage to material etc. and action taken
- Storage Location (if applicable)
- Corrective Action Taken
- Initials of person who received the incoming material.
- Comments section, for example note any concerns (e.g., mouse dropping found on some bags of seed, off-odours detected in carrier etc.).

### Record 2 - Sprout Returns Record

- Date product was returned
- Name of customer that returned the product
- Description of product
- Amount of product returned
- Lot number
- The reason for the returned product
- Name of person who received the returned product
- What was done with the returned product (e.g., dumped in garbage).
- Name of person who destroyed the product
- Comments section.

**Record 3 - Refrigerated Storage Temperature Record**

- Maximum Allowed Temperature Is
- Date
- Name of Storage Area
- Time
- Temperature
- Corrective Action Taken
- Checked By (name or initials)
- Comments Section.

**Record 4 - Equipment Calibration Record** i.e., Thermometer Calibration

- Date
- Reference Temperature
- Difference from Reference
- Corrective Action Taken
- Checked By (name or initials)
- Comments Section.

**Record 5 - Pest Monitoring Record**

- Date
- Pest Monitor #
- Rodent Traps
- Note Any Activity
- Corrective Action Taken
- Checked By (name or initials)
- Comments Section.

**Record 6 - Sprout Distribution Record (Retail/Wholesale/Distributor)**

- Date the sprouts were shipped
- The product name
- Lot code
- Quantity shipped to each account.
- The transporter (carrier)
- Who received the sprouts (customer)
- Record completed by (name or initials)
- Comments section.

**Record 7 - Sprout Packaging Record**

- Product Name
- Container Size/Type
- Date Packed
- Lot Number
- Seed Lot Number Used
- Number Packed
- Record Completed By (name or initials)
- Comments Section.

**Record 8 - Water Testing Record**

- Name of Testing Laboratory
- Date Sampled
- Sampled By
- Total Coliform Result
- *E. coli* Result
- Record Completed By (name or initials)
- Action Taken
- Result Interpretation Section

  For example:

  – If the coliform total is 5 cfu/g or less and there are zero *E. coli*, the water is safe to drink.

  – If the coliform level is 6 cfu/g or more and the *E. coli* is zero, the water should be considered unsafe for drinking.

  – If there are any *E. coli*, the water is considered unsafe to drink and corrective action must be taken immediately. Contact your local health unit for directions as to what to do in this situation.
- Comments Section.

**Record 9 - Visitor Sign-in/Sign-out Record**

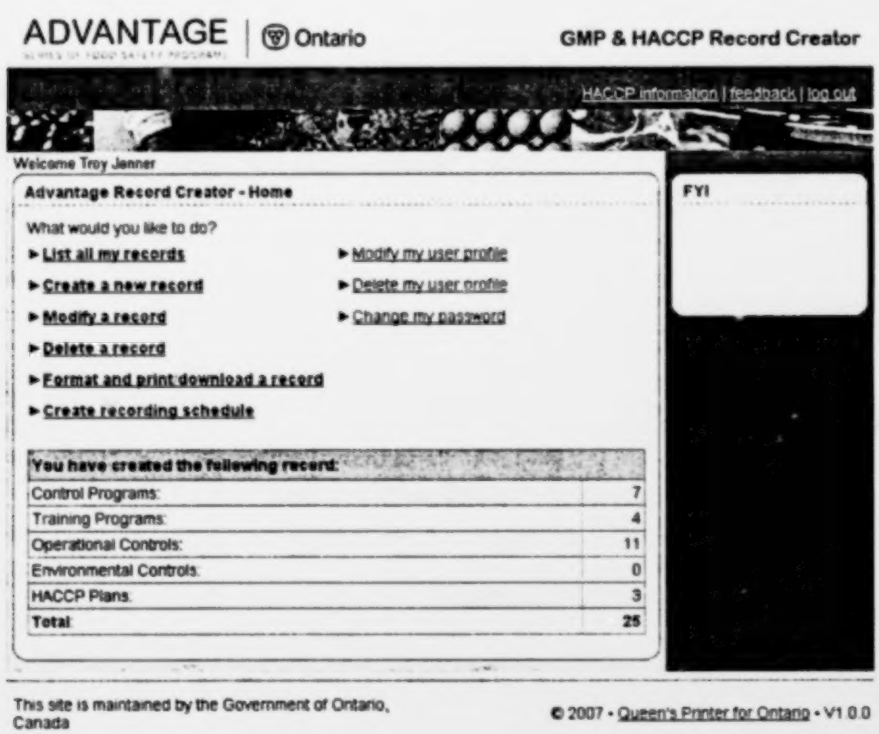
- Date
- Visitor's Name
- Company Name
- Person Visited
- Time Signed In
- Time Signed Out
- Initials or Name of Person Visited
- Reviewed GMP Safety and Security Policies.

**Record - 10 Retail/Wholesale/Distributor Information**

- The name of the account, type of account (e.g., restaurant, distributor, retailer, wholesaler)
- Address
- Contact Name
- Telephone #
- Fax
- E-mail.

**OMAFRA`s Record Creator**

OMAFRA is currently developing a Record Creator program. This is a web based tool that creates records from the standards and suggestions in the Advantage GMP program.



## S1 SEED PRODUCTION, RECEIVING and STORAGE

### S1.1 Imported Seed

Seed used for sprouting comes from many areas of the world. Seed has been identified as a source of human pathogens. While seed imported into Canada is not subject to pathogen testing it is subject to phytosanitary inspection (including the container in which it is shipped) by the Canadian Food Inspection Agency (CFIA) under the authority of the Plant Protection Act and Regulations, which are available at: http://laws.justice.gc.ca/en/ShowFullDoc/cs/P-14.8///en and http://laws.justice.gc.ca/en/showtdm/cr/SOR-95-212//?showtoc=&instrumentnumber=SOR-95-212. The purpose of the act is to protect plant life and the agricultural and forestry sectors of the Canadian economy by preventing the importation, exportation, and spread of pests, and by controlling or destroying pests in Canada.

The Canadian government does not test for human disease–causing pathogens because seed is not considered to be a food. The seed grower, importing broker or sprout grower may undertake testing.

**GAP Verification** Seed suppliers to the Canadian market should require that their seed producers sign documentation verifying that they have employed Good Agricultural Practices (GAPs) during production of the seed. (A brief outline of GAPs follows in the next section.) When this documentation is available, it should follow the seed lot to the seed supplier/distributor and finally to the grower.

**Pathogen-Testing Verification** Also important to sprouters is proof that the seed has been tested for human pathogens. Pathogens *E. coli* and *Salmonella* are of greatest concern. Better seed supplier/distributors test seed using scientifically accepted sampling and laboratory procedures. (See Section S2.7 for a discussion of microbial test results interpretation.) Where such documentation exists, it should accompany the seed and eventually become part of the sprouter's traceability records.

**Shipping** Vehicles/containers used for shipping seed should be clean and sanitary to prevent biological (e.g., feces from pests), chemical (e.g., traces from previous load), and physical (dust, glass, metal) contamination of the seed. To ensure sanitary shipping conditions, trucks/shipping containers should always be visually inspected for cleanliness before loading begins. Where

insect infestations are found or suspected, shipping containers should be fumigated.
Seed should be loaded in a manner to prevent damage to the seed (e.g., the load shifts, and bags fall and are torn open) or contamination. Humidity and/or moisture levels should be low enough to prevent growth of mould and/or bacteria on the seed. Materials intended for food (e.g., seed) and food contact materials (e.g., packaging materials) should be shipped separately from hazardous chemicals. Documentation should be available to the buyer to confirm that shipping vehicles/containers have met the standards listed above.

## S1.2 Good Agricultural Practices

Foodborne disease outbreaks have been traced back to seed contaminated by *Salmonella* or *E. coli* O157:H7.

Pathogens *E. coli* O157:H7 and *Salmonella* are sometimes present in the intestinal tracts and feces of animals, birds and humans. As a result, seed may become contaminated with fecal bacteria from field fertilization with raw manure, grazing livestock or wildlife, manure seepage from manure storage or livestock operations, irrigation with fecal-contaminated water or inadequate agricultural worker hygiene. Contamination may also be caused by unsanitary equipment used during harvesting, cleaning, and/or processing, or lack of adequate pest control. One study has shown that *Salmonella* can survive on alfalfa seed for months under dry storage conditions.

To reduce the risk of seed contamination, both domestic and foreign seed growers should follow GAPs in the production of seed intended for sprouting.

**Field Production**

Seed should not be produced on fields adjacent to livestock production operations, including grazing areas, where contamination from manure runoff, flooding by contaminated water or wind-borne microorganisms may occur. To further avoid fecal contamination, livestock should not be allowed to graze in seed production fields for at least 12 months before seed production. Wildlife should be kept off the fields as much as possible. Manure, biosolids and other natural fertilizers should be applied only after undergoing treatments (e.g., composting) that significantly reduce or

eliminate pathogens. If uncomposted manure is applied, OMAFRA suggests that manure not be applied in the year of seed harvest.

Water used for irrigation should be tested regularly to ensure that it is not contaminated with pathogens from animal or human waste, or by chemicals. Similarly, water used for pesticide application should not be contaminated with pathogens. Only pesticides registered for application on food-use crops should be used (some chemicals may be registered for use on seed crops where the seed is intended for planting but not where the seed is intended for sprouting for human consumption). Apply pesticides only at their recommended rates. Chemical applications (name, rate and date of application, etc.) should be recorded.

**Harvesting**

Harvesting equipment should be clean to prevent seed contamination. During harvest, equipment should be adjusted to prevent potentially contaminated soil from contacting the seed. Although some Chinese and Mongolian producers still harvest and sort by hand, there is no evidence that it carries a higher risk of contamination than seed processed mechanically.

Transportation equipment (trucks, wagons, etc.) should be clean and sanitary. If it has been used previously to transport animals, manure or chemicals, it should be properly cleaned and sanitized (e.g., pressure washed with hot water) before hauling seed destined for sprouting. Seed should be covered during transport to maintain cleanliness.

**Seed Cleaning**

Pathogenic bacteria can penetrate into cracks, crevices and damaged areas of seeds where they are inaccessible to seed disinfection treatments. Therefore, as many or damaged seeds as possible should be eliminated during the seed cleaning/conditioning process. Cleaning should also eliminate foreign material including soil, insect fragments, bird and rodent droppings, and metal and glass fragments.

**Pest Control**

Production and seed storage buildings should be of sound construction and in good repair to keep pests and weather out. Pests such as rodents, birds and insects should be controlled in seed cleaning, packaging and storage areas. A written pest control program that includes monitoring, eradication, cleaning, sanitation and record keeping should be in place. Cleaning and packaging equipment should be clean and sanitary. Equipment previously used to handle animal products should not be used to handle seeds intended for sprouting unless it has been thoroughly cleaned and sanitized.

**Personal Hygiene**

Workers in direct or indirect contact with seed intended for sprouting should follow the same hygiene rules that apply to other food handlers. Those who are sick or who have communicable diseases should not be allowed access to seeds in the field or in the processing facility where they may contaminate the seed. To ensure good personal hygiene, easily accessible sanitary facilities including washrooms and handwashing stations should be provided for workers.

Additional GAP information may be found in Chapter 3 of the Canadian Food Inspection Agency's *Code of Practice for the Hygienic Production of Sprouted Seeds*. It may be accessed at: www.inspection.gc.ca/english/plaveg/fresh/safsal/sprointe.shtml.

**Blending Seed Lots**

Seed lots are sometimes blended by supplier/distributors to improve lot quality, make more efficient use of very small lots, or for a number of other reasons. When blending takes place, precautions should be taken by the supplier/distributor to reduce the possibility of cross-contamination.

Ideally, before blending, each seed lot should be tested for pathogens to reduce the risk of contamination of "good" seed by contaminated seed. Alternatively, the mixed seed lot is tested for pathogenic *E. coli* and *Salmonella*. The lab results should be provided to the sprouter at the time of seed purchase so they become part of the sprouter's traceability records.

When seed lots are blended, it is important to create a record of the seed lots used in the new seed lot. Should a future food safety problem arise, such a record can be a valuable tool during an investigation.

**Seed Storage**

For clean, dry, conditioned seed, vented, single-use, clean, solid (multi-walled paper with a plastic liner) bags are preferred. Open-weave bags create a greater risk of seed contamination. However, they do permit air flow through seed that might otherwise mould in solid, non-vented bags. Every bag should be marked with a lot number.

Supplier/distributors' warehouses should be clean and protected from contamination by animals, insects and rodents, and from agricultural or industrial wastes and chemicals. A written pest control program that includes monitoring, eradication, cleaning, sanitation and record keeping should be in place.

Storage areas should be cleaned before use. Wash with a cleaner and use a sanitizer if the area is constructed of washable material. A list of acceptable cleaners and sanitizers may be found in the *Reference Listing of Accepted Construction Materials, Packaging Materials and Non-Food Chemical Products* at: www.inspection.gc.ca/english/fssa/reference/refere.shtml. Allow the area to dry before using. To avoid the possibility of generating resistant populations of pathogens, growers should vary the type of sanitizers used.

Storage areas that are constructed of materials that do not allow for the use of liquids (e.g., unpainted wood) should be dry cleaned (e.g., swept or vacuumed).

Seed in bags and in bulk bins should be stored off the floor (at least 15 cm) and away from walls (45 to 60 cm) to assist with pest control monitoring. Bulk bins or totes, etc. should be clean and free from pest (rodents, insects, birds, etc.) contamination. All stored seed should be covered to prevent entry of other biological, chemical or physical contaminants.

A First In, First Out (FIFO) inventory control system at the supplier/distributor warehouse will ensure that seed is shipped in proper rotation.

## S1.3 Receiving Seed

Individual bags or totes received by growers should be clearly marked with the following information either on tags or printed on the bag:

- The supplier/distributor's name and address
- A batch or lot identification number (ideally, the harvest/packing date can be identified from this information)
- Purity of the seed and germination rate
- The type of seed
- The net weight.

Seed should also meet predetermined specifications/standards for food safety and quality. For example, standards may include:

- Suitable packages or containers

- Physical evidence (e.g., clean, intact, undamaged packaging, proper colour texture, odour and flavour, no indication of pest infestation, etc.)
- Information supplied by the seed grower (e.g., pesticide application records, inspection tags, laboratory analysis, etc.)
- Results of tests undertaken by the shipper/distributor (e.g., ultraviolet light scan for evidence of rodent urine, laboratory analysis of random samples for pathogens, laboratory testing protocol, etc.)
- Assurance that seed lot numbers match certificates of country of origin, laboratory analysis results, etc.

Sprout growers should not accept seed that is delivered in dirty vehicles. Reject all torn or soiled bags because they may be contaminated. Visually inspect bags for signs of physical (e.g., filth, water stains), chemical (e.g., pesticide, cleaner/sanitizer) or biological (e.g., rodent, insect, or bird droppings) contamination. Insect, bird or rodent droppings or urine on the outside of seed bags can cause seed contamination despite the fact that it does not contact the seed directly. Regardless of the construction of the bag itself, workers moving or opening bags may contaminate their hands (or gloves) with the urine or droppings. Contaminated hands/gloves can then very easily cross-contaminate the seed.

Growers with black/ultraviolet light scanning devices should check for rodent urine. Train the receiving personnel to use the devices. Take them into the men's washroom, turn out the light, and examine the toilet or urinal or the floor immediately around either. Spots and streaks of urine will fluoresce under the UV light.

As indicated above, sprout growers should insist on documentation of *E. coli* O157:H7 and *Salmonella* laboratory testing results when purchasing seed. Buyers should also ask for the sampling methodology (if the sampling was inadequate, the test results may be suspect —see Section S2.4. However, sprout growers should remember that sampling and testing have limitations. Limitations are mentioned in Sections S2.2 and S2.3.

An example of seed pathogen testing information that should come from a seed supplier may be found on the International Specialty Supply Web site at: www.sproutnet.com/seed_certificate.htm. The testing information indicates presence or absence of *Salmonella*, *E. coli* O157:H7, generic *E. coli*, or *Listeria monocytogenes* in spent irrigation water after 48 hours of

seed growth. As a result, **negative test results do not guarantee the absence of *E. coli* O157:H7 and/or *Salmonella*** etc. on the seed. Obviously, lots of seed that test positive for *E. coli* O157:H7 and/or *Salmonella* must **not** be used for sprouting. Other seeds from the same grower/supplier that were produced under similar conditions should also be considered suspect.

A magnified visual inspection should also be conducted to ensure that seed is of good quality, clean and intact. Because the potential presence of pathogenic bacteria is greater in diseased or damaged seed, sprout growers may also wish to set a quality specification for seed (e.g., a maximum acceptable percentage of damaged seed).

Any product that fails to meet predetermined specifications/standards should be rejected.

Unload bags (or totes) carefully with the proper equipment so they are not damaged. Bags torn during unloading operations should be immediately closed using tape or their contents emptied into clean bags or containers that can be tightly closed. Any seeds that fall on the floor or that have otherwise been contaminated should be discarded. Chemicals, other ingredients and packaging materials should be received at a different time or location to prevent/minimize the possibility of cross-contamination.

**Lab Testing**

In the event that seed tests are undertaken by the receiver (grower), the seed should be clearly identified and stored separately to reduce the risk of cross-contamination until its pathogen status has been determined.

When seed has **not** been tested for pathogens before delivery, sprout growers should sample seed as soon as it is unloaded. Ideally, small, equally sized samples are taken according to a predetermined sampling plan.

Development of a sampling plan and seed sampling methodology is discussed in further detail in Sections S2.3 and S2.4.

## S1.4 Seed Storage

Seed should be stored separately in an enclosed, clean, ventilated, dry, cool room.

The seed storage area should prevent entry of birds, rodents and insects that can biologically contaminate seed with urine and feces. Seed is desired as food by rodents. An enclosed area will also protect seed from dust, debris and other contaminants.

Before seed is stored, the area should be cleaned and sanitized to prevent/minimize cross-contamination of the seed. To make cleaning easier and more effective, the storage area should be constructed of materials that are smooth and non-porous, and that can withstand repeated cleaning. Storage areas that do not lend themselves to wet cleaning should be dry cleaned (e.g., swept or vacuumed).

Low humidity will slow/discourage further growth of pathogens (*E. coli* and/or *Salmonella*), if they are present on the seed. Humidity and/or moisture levels should also be low enough to discourage/prevent growth of mould on the seed. Cool temperatures slow pathogen growth and, as a bonus, help preserve germination levels.

Seed should be stored on clean pallets so bags are at least 15 cm above the floor and 45 to 60 cm from walls. This will facilitate adequate airflow, cleaning and pest monitoring. Opened bags should be placed in clean, impermeable, pest-proof, sealed containers to reduce the risk of contamination. For the same reason, bulk storage bins should be tightly covered. Spills should be cleaned up immediately.

A written pest control program should be in place outlining a systematic approach for monitoring for pests and providing procedures to get rid of them.

Cleaning materials or other chemicals that have the potential to contaminate by spillage or by vapourizing should never be stored near seed.

A system of First In, First Out (FIFO) seed usage should be practised. This will require clear labelling and dating of incoming seed supplies to aid inventory identification and tracking.

## S2 PRE-PRODUCTION INSPECTION and TESTING

### S2.1 Seed Inspection

Scientists agree that the likelihood of seed contamination is reduced if Good agricultural Practices (GAPs) have been applied during seed production. However, it is often difficult for sprout growers to know the extent to which GAPs have been applied, or if they have been applied at all unless that information has been supplied by their seed supplier/distributor.

GAPs are just the first of several preventive measures and pathogen screening steps that should be used to ensure the safety of seeds for sprouting. The other steps should include seed sampling, seed inspection, pathogen testing of irrigation water from sprouting seed samples and seed sanitation before sprouting. As a group, these procedures increase the probability of finding or destroying pathogens, if they are present.

There is little point in spending time and money on seed pathogen testing if a visual inspection could result in rejection of the seed lot for other reasons. One major seed supplier reports rejecting more than 50 per cent of seed lots sampled since it started its seed screening program. Nearly all of the rejected lots resulted from its inspection process, not from pathogen testing.

Prior to purchasing or accepting seed, growers should thoroughly inspect, under magnification, a representative sample of the seed for evidence of contamination and damage, as described below.

After receiving a shipment and sampling the seed using the procedures described in Sections S2.3 and S2.4, the seed should be inspected under magnification prior to sprouting for pathogen testing.

After a sample is taken from each bag, the composite sample should be inspected for indications of contamination. Inspection should be done with a magnifying glass, a microscope and the naked eye. Look for mouse droppings, urine, insect excreta, damaged seeds, foreign objects and other types of contamination. Those with access to a "black light" should use it to check for the characteristic fluorescent orange colour produced by rodent urine.

International Specialty Supply (ISS), a U.S. seed supplier, reports finding mouse droppings, glass, seed that had been treated with a fungicide, silica, iron filings, mouse parts, insect parts, dirt, organic matter and several other types foreign material in incoming seed lots. The company noted that feces and damaged seed comprise the great majority of rejections resulting from physical inspection. Urine in the seed has been found only four times.

Depending on the type of seed being inspected, a microscope can be used to detect damaged seed. The only way to get an accurate count of damaged seed is to separate out 100 or more seeds. Pick out the damaged ones. An alfalfa seed has two sides. Turn each remaining seed over and inspect it for damage. Count the number of damaged seeds, compare to the number of undamaged seeds and calculate the percentage of damaged seed.

There is a faster, although less accurate, way to determine the percentage of damaged seed. Assume that for each visible damaged seed, there is another that is broken on the other side and not visible. Count the number of seeds that are damaged on the side facing you and double that number. Then count the number of seeds that are broken in two or broken on one or both ends. Add the two numbers together and calculate the percentage of the total.

Mouse droppings can be misidentified as dirt. However, with practice, they are easy to find and are easily identified under a microscope by their fibrous consistency.

ISS reports that the main cause of rejection of seed resulting from pathogen testing was generic *E. coli*.

## S2.2 Is There Value in Preproduction Microbial Testing?

Even if GAPs have been used and the seed has been inspected, pathogens may still be present on seeds intended for sprouting.

Once pathogens are present on seeds, they are able to survive for extended periods of time.

If pathogens are present, they may be difficult to detect for several reasons.

- Pathogens may reside inside microscopic cracks on the seed surface, or even inside the seed, making them physically inaccessible.
- Levels of pathogens are usually so low that, from a statistical standpoint, many seeds would have to be tested in order to achieve detection.
- Pathogens may or may not be randomly distributed within the seed lot. Again, microbial testing would need to be applied to a large percentage of seed to have a reasonable assurance of finding pathogens.

Rather than testing the seed itself, scientific literature suggests that a more accurate indication of seed contamination can be achieved by collecting representative seed samples, sprouting them in a commercial setting, then analyzing spent irrigation water collected from the growing sprout sample.

**Testing Spent Irrigation Water**

There may be several reasons that screening spent irrigation water appears to be more accurate. Once sprouting begins, pathogen growth is stimulated and supported by nutrients released from the seed, readily available water and warm temperatures. This increases the pathogen population by 1,000 to one million times so pathogens become easier to detect. As seeds germinate, pathogens residing in seed cracks and crevices expand their presence to areas on the surface of the seed. Irrigation water washes over the surface of the seeds and emerging sprout and, in doing so, washes some pathogens into the spent irrigation water.

The scientific community believes that collecting sprout irrigation water from one irrigation cycle 48 to 96 hours after sprouting begins provides a representative sample from all the seeds. Irrigation water chlorinated at a low concentration level does not affect the pathogen level in the spent irrigation water. However, the seed should not be disinfected before seed sprouting and irrigation water testing begins for the test seed lots. Seeds used for production of sprouts should be sanitized.

Health Canada's Amendment to MFHPB-20 analysis uses a slightly different approach (www.hc-sc.gc.ca/fn-an/res-rech/analy-meth/microbio/volume2/mfhpb20a-01_e.html) to test for *Salmonella* in germinating seeds. Seeds (125 g) are kept covered in unchanged sterile water at 30ºC for three days. A slurry of the mass is created and enriched with a nutrient broth before analysis using MFHPB-20 methodology (www.hc-sc.gc.ca/fn-an/res-rech/analy-meth/microbio/volume2/mfhpb20-

01_e.html). While not documented, some sprout growers believe this method is better at locating pathogens in lightly contaminated seed.

ISS reports that none of its seed has been implicated in an illness outbreak since the company initiated seed sampling, seed inspection, sprout growing (of the seed sample), spent irrigation water sampling, enrichment of sampled water (to multiply pathogen numbers for easier detection) and pathogen screening in 1999. There was no indication of how many contaminated seed batches were detected and rejected. Using similar testing methods, other seed suppliers should also be able to supply safe seed.

**Testing Sprouts**

Sprouts may also be tested for pathogens. There are disadvantages and advantages to this method.

In order to collect a representative sample, a very large number of samples should be taken. Health Canada's *Sample Collection and Testing for Sprouts and Spent Irrigation Water* requires that 5 sample units of approximately 200 g each should be aseptically collected from different locations in the drum or growing trays. Sample units should be collected throughout the entire production lot (e.g., from top to bottom, side to side, and front to back of the drum or trays).

The link for Health Canada's *Sample Collection and Testing for Sprouts and Spent Irrigation Water* is:
www.hc-sc.gc.ca/fn-an/alt_formats/hpfb-dgpsa/pdf/legislation/sprout_water_testing_analyse_pousses_eau_e.pdf.

In some growing configurations, sprout irrigation water may be difficult to collect. Research indicates that levels of *E. coli* detection in irrigation water may be 1 $\log_{10}$ less[1] than that found on sprouts. At this time, laboratory ability to detect *E. coli* is also lower than its ability to detect *Salmonella* in irrigation water. The FDA recommends irrigation water testing over sprout testing.

Spent irrigation water from soil-grown sprouts cannot be effectively used for testing seeds for pathogens.

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[1] "Log" is the abbreviation of logarithm; each log reduction decreases the pathogen population by 90 per cent—see section S3.1, Why Disinfect Seed, for a more detailed explanation.

While microbial testing may identify a portion of those pathogens present in contaminated seed, testing cannot guarantee discovery of all the pathogens. Even a negative test result does not guarantee the absence of pathogens. However, it does provide a level of assurance that a batch of sprouts is probably free of contamination.

## S2.3 Developing a Seed Sampling Plan

There is substantial evidence that contaminated seed is responsible for the great majority of sprout-related illness outbreaks. Given that there is no method of sanitizing seed that is 100 per cent effective, in order to produce safe sprouts:

**Sprout growers need to ensure that the seed they use is not contaminated before using it in production.**

In order to find pathogens in seed prior to sprouting, the pathogen should be captured and identified. Alternatively, a sprouter may capture and identify *evidence* of contamination. Seed sampling is a method of capturing a pathogen or evidence of contamination for identification.

In order for analysis to be statistically valid, sampling methods should be designed to ensure that samples represent the entire lot of seed. It is known that the greater the number of samples and the larger the size of the samples, the greater the probability of pathogen detection or detection of evidence of contamination. This is especially important at low levels of contamination and when pathogen distribution is irregular.

Seed sampling methods for germination and purity tests are quite different than those trying to determine if the seed is contaminated. Seed sampling methods for germination and purity tests are designed to determine the exact percentage of seed that will germinate and the exact percentage of undesirable seeds. This can be done quite accurately by random sampling and narrowing that sample down to a few hundred seeds for testing.

However, when trying to determine if seed is contaminated, the object is not to find out how many pathogens are present, but to determine if **any pathogens** are present. In this case, sample size becomes the main determining factor in accuracy.

**Detection Probability**

ISS charted the statistical probability of finding pathogens in seeds based on different sample sizes and different levels of pathogen contamination. *Probability of Finding a Pathogen in a Twenty-Ton Lot of Alfalfa Seed Contaminated with Various Contamination Levels per Kilogram*, may be accessed on the ISS Web site at:
www.sproutnet.com/sprouting%5Fseed%5Fsafety.htm

Selected information from the chart follows.

- In a 20 ton lot of alfalfa seed if the contamination rate is 4 cfu (colony-forming units is a measure of viable bacteria numbers), the probability of locating pathogens (if they are present) in a 20 g sample (10,000 seeds) is only 7.69 per cent. If the contamination rate is 1 cfu, the probability of detection in the same sample decreases to only 1.98 per cent. However, at a contamination rate of 10 cfu, the probability level increases to 18.13 per cent. All are far below acceptable detection levels.
- In a 1 kg seed sample (50 × 20 gram samples or 500,000 seeds) with a contamination rate of 4 cfu, the probability of pathogen detection (if pathogens are present) rises dramatically to 98.17 per cent. At a contamination rate of 1 cfu, the probability of pathogen detection in a 1 kg sample falls to 63.21 per cent. At 10 cfu, pathogens will be detected 99.99 per cent of the time.
- When a 5 kg sample (250 × 20 gram samples or 2,500,000 seeds) is used, the probability of detecting pathogens (if they are present) is 99.99 per cent when pathogen levels are both 4 cfu and 10 cfu. At 1 cfu, the probability is 99.33 per cent.

The chart used assumes uniform distribution of pathogens in the seed. In reality, pathogen distribution will likely be irregular, making detection more difficult. In reality, the overall sample size will depend upon the number of bags sampled and the size of each individual sample taken.

**Small Growers**

Small sprout growers and/or buyers of small lots may not have the resources necessary to test all incoming seed for pathogens. Ask for a certificate of sampling and insist on documentation of *E. coli* O157:H7 and *Salmonella* laboratory testing results when purchasing seed. Carefully examine all documentation. Ask for references. Beware of claims by seed suppliers (such as "pathogen free") that cannot be substantiated. As a

further precaution, seed should be carefully examined upon receipt, as described in Section S1.3.

**Effective Sampling**

**An effective sampling program requires seed samples from every bag of seed.** Sampling every bag is not difficult, nor is it significantly more costly than sampling a random portion of the bags. Compared to the time and cost involved in a recall, the extra cost of sampling every bag is insignificant.

Equal-sized samples should be taken from every bag of seed. Suppose your sprout operation has just taken delivery of six pallets of seed. There are 40 × 25-kg bags on each pallet for a total lot size of 240 bags. If a 20 g sample is extracted from each bag, a 4,800 g (4.8 kg) test sample will result. The statistical probability of discovering pathogens (if they're present) during sprouting of this size sample is extremely high (greater than 99.99 per cent).

## S2.4 Seed Sampling Methodology

Samples of seed are usually taken with a probe or trier. The probe should be long enough to reach all areas of the bag or bulk bin. In bagged seed, probe a horizontal bag diagonally from corner to corner (e.g., top right corner to bottom left corner). The probe should have enough slots to sample along the full horizontal distance. Insert the probe into the bag with the slots closed and facing downward. Once fully inserted, rotate the probe slots so they face upward, and then open them. Once seed has filled the probe, close the slots and withdraw the probe. Cover holes in the bags with a sticker that completely seals the hole. Place seed in a clean, sanitary container and probe the next bag. An equal amount of seed should be removed from each bag (minimum 20 g is suggested).

When sampling seed in bulk, far more probes should be made. As with bag sampling, the probe is fully inserted, rotated, opened, and then closed before withdrawal. Unlike bags, in bulk bins or totes, the probes should be inserted from the top only, not the bottom. The probe should be inserted at an angle near the four corners of the bin/tote and in the centre.

It is very important to use aseptic sampling methods when taking any sample. Hand sampling, which carries a higher risk of cross-contamination, is not recommended.

For germination or purity testing, individual samples from the same lot should be thoroughly mixed together.

Mixing individual samples for test sprouting is **not necessary** because the entire sample will be sprouted and the spent irrigation water tested. For those who insist on mixing, individual samples should be hygienically mixed together in a manner that will not further contaminate the seed. A sanitized food-grade metal or food-grade plastic paddle or bar may be used. Never use bare hands or anything made of wood to mix seeds intended for microbial testing. Both may contaminate the seeds.

Additional seed sampling information may be found at:
www.extension.iastate.edu/Publications/NCR403.pdf or
www.ext.nodak.edu/extpubs/plantsci/smgrains/ncr403w.htm

## S2.5 Sample Growing Methodology

As noted in Section S2.2, scientific literature suggests that a more accurate indication of seed contamination can be achieved by collecting representative seed samples, sprouting them in a commercial setting, then analyzing spent irrigation water collected from the growing sprout sample. Section S2.3 quoted a probability chart indicating that the larger the sample sprouted, the greater the likelihood of detecting pathogens in irrigation water. Combined, this leads to the conclusion that spent irrigation water from large samples of seeds is the most effective way to screen for pathogens.

Laboratories can grow seeds and collect irrigation water only from small seed samples. Large samples (e.g., larger than 1 kg) can be sprouted only in a commercial facility. Therefore, sprouting and irrigation water collection should take place in a commercial setting and the irrigation water should be tested in a laboratory.

So that the test can provide a true indication of the presence or absence of pathogens, do not sanitize the seed sample before sprouting. Sample sprouting should take place within the sprout facility, but in a growth area separate from commercial sprouting operations, when possible. Sprouting methods and conditions (e.g., frequency of irrigation, nutrients) should be identical to those of the commercial sprouting areas. However, warmer

water than is normally used will encourage pathogen growth. As with commercial sprouts, bacteria levels (some of which may be pathogens) will increase by 1,000 to 10,000 times.

In most cases, pathogen levels reach their maximum level in 48 to 96 hours then decline slightly. However, the lower the initial level of pathogen contamination, the longer the period of time required to reach the maximum pathogen level. Some seeds (e.g., broccoli, onion, clover) are slow germinators so pathogens, if present, require a longer period to reach detectable levels. Injured *Salmonella* or *E. coli* can also experience a lag in growth times. Considering these factors, the sample should not be taken at less than 48 hours.

## S2.6 Irrigation Water Collection Methodology

The same methodology used for collecting spent irrigation water from sprouts being grown for commercial sale should be used for collecting irrigation water from sprouting seed samples.

It is very important to use aseptic procedures for sample collection, storage and transportation to the lab in order to avoid sample contamination. The lab will provide instructions regarding the procedures required. Collection personnel should be trained in aseptic collection techniques and practise collection of representative samples before actual collecting begins.

Sampling tools and sample containers should be clean and sterile. Containers should be dry, leak-proof, wide-mouthed, of suitable size, and clearly labelled. Collection personnel should wear a clean lab coat or coveralls, a hair net, and sterile gloves so they do not contaminate the sample. Hands should be washed prior to putting on the single-use, sterile gloves. Those sampling should also use a sanitizing (i.e., iodophor) glove dip immediately prior to sampling. While collecting samples, gloved hands should be kept away from the mouth, nose, eyes and face to prevent contamination.

If a sampling tool is used, it should be protected from contamination before and during use.

Sample containers should be opened only immediately before sample collection and then closed immediately after. In order not to contaminate

the sample, be very careful how lids from sterile sample containers are held while collecting the sample. They should not be held in hand and not placed in another location during water collection.

Because the distribution of pathogens is not uniform throughout a sprouting container (bin/tray), a single water sample from a single location under the container may not provide an adequate representation of the actual microbial load throughout the container. Thus, all practical efforts should be made to obtain a sample that is as representative as possible of the entire sprouts batch. Health Canada's *Sample Collection and Testing for Sprouts and Spent Irrigation Water* requires 1 L of irrigation water to be collected. The link for Health Canada's, *Sample Collection and Testing for Sprouts and Spent Irrigation Water* is:
www.hc-sc.gc.ca/fn-an/alt_formats/hpfb-dgpsa/pdf/legislation/sprout_water_testing_analyse_pousses_eau_e.pdf.

If there is a common trough collecting the spent irrigation water, the water should be collected at the trough outlet. However, if there is no common collection point, a representative sample totalling 1 L should be collected as the irrigation water runs through the bin or trays. For example, when collecting 1 L, if there are five trays, collect 200 ml from each tray or if there are 10 trays, collect 100 ml from each tray for a total volume of 1 L. When there are more than 10 trays, it will be necessary to prepare a sampling whereby 10 × 100 ml samples are collected from throughout the entire production lot. (e.g., if there are 30 trays, collect 100 ml of spent irrigation water from every third tray).

Where sprout samples are collected for testing, the same aseptic procedures should be used. Health Canada's *Sample Collection and Testing for Sprouts and Spent Irrigation Water* requires that five sample units of approximately 200 g each should be aseptically collected from different locations in the drum or growing trays. Sample units should be collected throughout the entire production lot (e.g., from top to bottom, side to side, and front to back of the drum or trays).

Perishable sprout samples should be delivered to the laboratory promptly after collection. If this is not possible, the samples should be kept at temperatures between 0 and 4°C. Sprout sample delivery to the lab should always be within 24 hours of collection.

## S2.7 Interpreting Microbial test Results

In Canada, Health Canada's laboratory procedure MFHPB-20 (available at: www.hc-sc.gc.ca/fn-an/res-rech/analy-meth/microbio/volume2/mfhpb20-01_e.html) is used to isolate and identify *Salmonella* in a variety of foods, including sprouts. To analyze sprouts for coliforms, *E. coli* and *Klebsiella pneumoniae*, laboratory procedure MFLP-64 is used (see www.hc-sc.gc.ca/fn-an/alt_formats/hpfb-dgpsa/pdf/res-rech/mflp64_e.pdf). Procedure MFHPB-19 is used to confirm these microorganisms (see www.hc-sc.gc.ca/fn-an/res-rech/analy-meth/microbio/volume2/mfhpb19-01_e.html).

The United States FDA's accepted microbial testing procedures may be found at: www.cfsan.fda.gov/~dms/sprougd2.html.

For Canadian sprout growers, Health Canada has published the *Health Products and Food Branch (HPFB) Standards and Guidelines for Microbiological Safety of Food—An Interpretive Summary* for a number of foods including sprouted seeds. The document may be found at www.hc-sc.gc.ca/fn-an/res-rech/analy-meth/microbio/volume1/intsum-somexp_e.html

Sprouts are listed in the Health Canada document (as Table 3d) and are summarized below in Table 1.

| FOOD CATEGORY | METHOD OR EQUIVALENT | GUIDELINE | NATURE OF CONCERN | SAMPLING PARAMETERS | | | |
|---|---|---|---|---|---|---|---|
| | | | | n | c | m | M |
| Sprouted Seeds (e.g., Alfalfa and Bean Sprouts) | MFHPB-19 | Fecal Coliforms | Sanitation | 5 | 2 | $10^3$ | $10^5$ |
| | MFHPB-19 | *E.coli* | Health 2[F] | 5 | 2 | $10^2$ | $10^3$ |
| | MFHPB-20 | *Salmonella* | Health 2[G] | 5 | 0 | 0 | - |

**n-** number of samples
**c -** maximum number of marginally acceptable samples; when this number is exceeded, the lot becomes unacceptable
**m -** acceptable concentrations of microorganisms per gram or millilitre
**M -** unacceptable concentrations of microorganisms per gram or millilitre Health 2 represents a situation that could cause temporary, not life-threatening, adverse health consequences.
**F -** This becomes a Health 1 concern if verotoxin-producing strains are found.
**G -** This becomes a Health 1 concern if targeted or distributed to a sensitive population, such as children less than five years of age, the elderly, or immunocompromised individuals (AIDS patients, transplant recipients, cancer patients etc.). Health 1 represents a situation that could cause serious adverse health consequences or death.

Of the five samples required by Health Canada, two can have fecal coliforms between $10^3$ cfu/ml (1,000 colony-forming units per millilitre) and $10^5$ (100,000) cfu/ml and still be acceptable. Three samples in this range would deem the lot unacceptable. One sample with a fecal coliform population greater than $10^5$ would also make the lot unacceptable, with the nature of the concern being sanitation.
Much lower levels of *E. coli* are acceptable on two of the five samples. High numbers of generic *E. coli* are generally an indication of poor sanitation. If the sanitation process is not eliminating generic *E. coli*, it will not eliminate any *E. coli* O157:H7 that may be present. There is no acceptable level of *E. coli* O157:H7.

There is also no acceptable level of *Salmonella* on any samples.

Coliforms and generic *E. coli* may be found naturally on or within plant tissue. When this occurs, testing for either provides limited information as to the sanitary quality of the sprouts. Pathogen screening for *E. coli* O157:H7 and *Salmonella* is most appropriate to gauge the contamination level of the seed.

Regardless of the tests employed, all test results should be interpreted with caution.

When test results are negative, the results are assumed to be correct. However, a negative result does not guarantee that there is no *E. coli* O157:H7 and/or *Salmonella* on the seed. Pathogens still may be present; they just were not found. From a legal standpoint, testing does provide evidence of due diligence on the part of the sprout producer. All Good Manufacturing Practices (GMPs) should still be followed carefully during sprouting, packaging, storage and transportation.

**If the seed lot sample screens positive for generic *E. coli* and/or *Salmonella*, the test should be presumed to be correct** (presumptive positive) and it is assumed that the seed is contaminated. At this point, the grower has two options.

Option 1: Agree that the seed is contaminated and not use it for sprouting. Destroy the crop before any more time and resources are used, before these sprouts further contaminate other production batches and before it enters the food supply

Option 2: Hold the crop and request a confirmatory test (or tests) from the enriched culture of the original spent irrigation water sample to determine if *E. coli* O157:H7 and/or *Salmonella* are indisputably present. This can be confirmed by biochemical (i.e., MFHPB-19) or genetic methods. If the confirmatory tests are **negative**, the seed may be considered free of *E. coli* O157:H7 and/or *Salmonella* and used for sprouting.

If the confirmatory test is **positive** for pathogens, the grower can destroy the crop before it is sold for human consumption.

Although **retesting** is routine in the food industry, it may be wise for sprout growers not to follow this practice. A negative result during a second series of tests may lead the grower to falsely conclude that the seed is safe when, in fact, it is not. The most prudent choice is to accept the initial finding rather than trying to prove that it is incorrect.

If the seed is declared contaminated, cautious growers assume that all other seed from the same lot is are also contaminated. This seed should not be used for sprouting. The seed may be returned to the supplier, discarded or diverted into other, non-food use.

Anything in the sprouting facility that came into contact with seed that has been identified as contaminated should be thoroughly cleaned and sanitized to prevent contamination of other batches of seed. Until further test results are known, seed should be stored separately.

## S3 SEED DISINFECTION

### S3.1 Why Disinfect Seed?

The application of GAPs during seed production and seed inspection as well as laboratory testing of spent irrigation water collected from a large sample of pregrown seed are essential for reducing the risk of pathogens on seed intended for sprouting. However, even with these preventive steps, there can be no absolute guarantee that seed will be pathogen free.

Seed disinfection further decreases the risk of microbial pathogens on seed. Disinfection is additional to the use of Good Manufacturing Practices (GMPs) during sprout production.

Scientists and sprout growers have been working hard to discover the "magic bullet" for seed disinfection; the treatment or combination of treatments that will eliminate pathogens from seed or, as a minimum, reduce their level by 5 $\log_{10}$ (99.999 per cent). Scientific studies suggest that seed disinfection using 20,000 ppm chlorine can reliably achieve only a 2.0 $\log_{10}$ (99 per cent) to 3.0 $\log_{10}$ (99.9 per cent) reduction in pathogen populations.

According to Montville and Schaffner's *Monte Carlo Simulation of Pathogen Behavior during the Sprout Production Process*, in all cases seed disinfection reduced the percentage of contaminated sprout batches. (See www.foodsci.rutgers.edu/schaffner/pdf%20files/Montville%20AEM%202005.pdf). However,

**NO KNOWN SEED DISINFECTION TREATMENT GUARANTEES COMPLETE PATHOGEN ELIMINATION FROM SEED**

The CFIA allows seed disinfection prior to sprouting but, pending clear guidance from Health Canada, does not recommend specific chlorine levels. A solution containing 20,000 ppm chlorine is a 2% solution of chlorine. This is a strong solution of chlorine which is a challenge to work with and to dispose of. There is little evidence that 20,000 ppm chlorine is significantly more effective than a 2,000 ppm chlorine solution as a seed disinfection treatment when properly used.

In its *Guidance for Industry, Reducing Microbial Food Safety Hazards for Sprouted Seeds* (www.cfsan.fda.gov/~dms/sprougd1.html) the United States FDA states, "Seeds for sprouting should be treated with one or more treatments (such as 20,000 ppm calcium hypochlorite) that have been approved for reduction of pathogens in seeds or sprouts. At least one approved antimicrobial treatment should be applied immediately before sprouting. Sprouters should carefully follow all label directions when mixing and using antimicrobial chemicals."

During seed germination, pathogen survivors of disinfection treatments often multiply back to almost the exact levels that they were before disinfection.

Depending upon the certifying body (there are many in Canada), many organic sprout growers cannot or will not use chlorine, but some others may. For example, the OCPP/Pro-Cert Canada standard states, "Seed or growing sprouts shall not be rinsed or immersed in water with chemicals capable of releasing chlorine in solution in excess of federal quality standards." However, some organic growers do use a chlorine disinfectant treatment but only if there is sufficient rinsing with water to remove all chlorine residues from the seed. On the other hand, the U.S. National Organics Standards Board has been non-committal about chlorine disinfection seed soaks. Even the most stringent organic standards do not reject the use of all chemicals. As a result, organic growers may use hydrogen peroxide or an acetic acid mixture as a disinfectant.

It should also be noted that seed disinfection is most effective on microorganisms found on the seed surface. Microbes present in cracks and crevices of the seed are largely unaffected by disinfection. As a result, regardless of the method of disinfection, elimination of microorganisms below a "plateau" level is believed to be nearly impossible. For example, suppose there are 100,000 organisms per gram on the surface and 1,000 organisms per gram residing in inaccessible cracks. In the unlikely event that every microorganism found on the surface is killed during seed disinfection, 1,000 organisms per gram still remain in the cracks to multiply during germination. If there is only a 3 $\log_{10}$ kill of the surface microorganisms (99.9 per cent $\times$ 100,000) 99,900 microbes are killed and 100 organisms per gram survive. Therefore, 100 organisms per gram remain to multiply during germination. During normal sprouting conditions these organisms could easily multiply to greater than 1,000,000 organisms

per gram. This shows how important it is to have pathogen-free seed and good seed disinfection practices.

A brief explanation of the term "log" may be useful here. "Log" is the abbreviation of "logarithm." A logarithm is a "power of ten" ($10^1$). Each logarithmic (log) reduction reduces the pathogen population by 90 per cent.

For example, if the seed surface microbial population were 100,000 organisms per gram of seed, a 1 $\log_{10}$ reduction (or kill) reduces the surface microbial population by 90 per cent to 10,000 microbes per gram of seed.

$$100{,}000 - (100{,}000 \times .90) = 100{,}000 - 90{,}000 = 10{,}000 \text{ (1-log reduction)}$$

A 2 $\log_{10}$ reduction reduces the surface population from the 1-log reduction level of 10,000 to 1,000 microbes per gram of seed.

$$10{,}000 - (10{,}000 \times .90) = 10{,}000 - 9{,}000 = 1{,}000 \text{ (2 } \log_{10} \text{ reduction)}$$

A 3 $\log_{10}$ reduction reduces the surface population from the 2 $\log_{10}$ reduction level of 1,000 to 100 microbes per gram of seed.

$$1{,}000 - (1{,}000 \times .90) = 1{,}000 - 900 = 100 \text{ (3 } \log_{10} \text{ reduction)}$$

Or, to put it in another way, a 3 $\log_{10}$ reduction means that there has been a 99.9 per cent reduction of the seed surface microbial population.

Low (or no) microbial population on the seed before sprouting is important because sprouting conditions (warm, wet and a food source) encourage exponential microbial growth. Scientific studies have found that pathogen populations increase by $10^3 - 10^6$ (1,000 to 1,000,000 times) during sprouting.

As noted in Section S2.2, maximum pathogen levels are generally reached 48 to 96 hours after initiation of sprouting.

## S3.2 Disinfection Options

Dr. William A. Fett, the lead scientist of the USDA's Food Safety Intervention Technologies Research Unit at Wyndmoor, Pennsylvania, has conducted an extensive investigation of research papers describing chemical and physical interventions for reducing pathogens on inoculated

sprouting seed. A summary of his findings is included in Table 2 at the end of this section, *Chemical and Physical Interventions for Reducing Pathogens on Inoculated Sprouting Seed.* While many treatments show promise, it should be noted that the results described were achieved under laboratory conditions.

Chlorine is the most commonly used seed treatment.

Chlorine seed treatment involves a delicate balancing act between eliminating as many pathogens as possible with high chlorine concentrations while keeping concentration levels low enough to maintain seed viability and germination, and sprout seedling vigour. When deciding on the concentration level, growers should take into consideration the sensitivity of the seed to the sanitizer, the type of seed being treated, and surface features of the seed (the rougher the seed surface, the more hidden and protected the pathogens and the harder they are to destroy).

As indicated in Dr. Fett's summary, tests have been conducted with a number of other chemicals (hydrogen peroxide, peroxyacetic acid, ethanol, chlorine dioxide, and acidified sodium chlorite), combinations of chemicals, and surfactants using various concentration levels and various contact times. Ozonated water has also been used. Irradiation of seeds has shown promise in preliminary testing but has not yet been approved for use.

High-capacity, patented, seed pasteurizing equipment is suitable for large-volume sprouting operations and is commonly used in Asia. The seed and water are heated to about 80°C for 10 to 20 seconds. Time and temperature are closely controlled by electronic technology. Studies by Dr. Randy Worobo at Cornell University on the use of lower temperature and longer time heat treatments also show promise.

Another innovative treatment includes an oxycholoro-based or SDH sanitizer named Germin-8-or. There have been promising scientific test results by Dr. Keith Warriner, University of Guelph, with a range of seeds including mung beans, alfalfa and soybeans inoculated with *E. coli* O157:H7 and *Salmonella.*

## S3.3 Seed Prewash

To maximize their effectiveness, antimicrobial agents (e.g., calcium hypochlorite) should have direct contact with the microorganism (e.g., *E. coli* O157:H7 and/or *Salmonella*) in order to kill it. The presence of surface organic matter (dirt or other extraneous material) greatly reduces the sanitizing effect. Therefore, seeds should be as clean as possible. Effective washing may also reduce pathogen levels by up to 1 $\log_{10}$ (90 per cent) and separate damaged seeds, which float to the surface of the wash water.

Elimination of pathogens is important, but so is prevention of contamination of the seed. The microflora (bacteria, viruses, yeast and moulds) of the seed are composed of both microbes within the seed and those acquired from its environment. For this reason, high sanitation standards should be maintained throughout the entire sprouting process. Seed preparation should take place in a sanitary area separate from seed and chemical storage areas, and away from germination and packaging activities. Before washing any batch of seeds, all equipment (containers, sieves, handling equipment, etc.) should be thoroughly cleaned and sanitized using chemicals acceptable to the CFIA as listed in its *Reference Listing of Accepted Construction Materials, Packaging Materials, and Non-Food Chemical Products,* available at: www.inspection.gc.ca/english/fssa/reference/refere.shtml.

Before seed bags are brought into the prewash area, they should be inspected for contamination including that caused by rodents (use a black light if one is available). Reject soiled bags. As seed is being poured into the washing container, be careful not to touch the seed with bare hands or dirty gloves. Leftover seed should be stored in a covered, clean, labelled container.

Place unwashed seed in a clean container large enough to allow the addition of a large volume of potable water. Agitate the seed/water mixture with enough force that all seeds become wet and the mechanical action of the seeds rubbing together helps remove surface dirt. Skim damaged seeds and debris that floats to the surface with a sanitary utensil before draining water from the seed. Repeat this procedure until the drained water is clear. At this point, the seeds should be clean enough to proceed to the sanitizing step.

Microorganisms (including pathogens, if they are present) are extremely difficult to eliminate below a "plateau" level during seed disinfection. Most experts agree that water absorbed by seed causes cracks to close, making pathogens even more inaccessible and minimizing the internal uptake of sanitizer. This emphasizes the need to use clean, pathogen-free seed rather than relying on seed disinfection treatments.

## S3.4 Mixing Chlorine Solutions

Calcium hypochlorite is a common form of chlorine used to sanitize seeds. Acting as hypochlorous acid, it contains 65–70 per cent available chlorine.

The effectiveness of a chlorine solution is determined by pH, temperature, contact time with the surface, concentration level and the amount of organic matter present on the surface to be disinfected. Because the concentration level of chlorine affects the efficacy of seed disinfection, the concentration level should always be checked before use.

Although a slightly alkaline pH solution produces the maximum amount of hypochlorous acid (the active ingredient in a chlorine solution), a neutral pH (6.5–7.5) is generally effective. pH adjustment is rarely needed. If in doubt, pH test strips can be used. In the unlikely event that adjustment is necessary, water pH should be raised or lowered before the introduction of chlorine. Calcium hypochlorite is less pH sensitive than sodium hypochlorite.

Chlorine is most effective when used in warm water (24°C–30°C). Like very low pH, using hot water greater than 30°C decreases chlorine availability in the solution and shortens the time of its effectiveness. At high temperatures or acidic pH, dangerous chlorine gas is released. Always use clean, potable water, as organic material rapidly reduces the effectiveness of chlorine.

**Improperly handled, chlorine is a dangerous chemical.** Follow manufacturer's directions carefully during preparation of chlorine solutions. Do not leave open containers of chlorine anywhere where there is moisture or humidity. Under these conditions, containers of concentrated chlorine may explode.

All preparation should take place in a well-ventilated area. Inhalation may cause burning of the upper respiratory tract, coughing, laryngitis, shortness of breath, headache, nausea and vomiting. Swallowing chlorine can cause severe burns to the mouth, throat and stomach. Chlorine can be corrosive to the skin, causing redness, pain and burning. Blurred vision, redness, pain and tissue burns can result from eye contact.

During chlorine preparation, National Institute for Occupational Safety and Health (NIOSH)–approved respirators should be worn. Contact the Ontario Ministry of Labour (www.labour.gov.on.ca/english ) or a safety equipment supplier for specific respirator information.
To prevent personal injury resulting from hazardous fumes and/or skin contact, rubber gloves, chemical-resistant footwear, coveralls, a chemical-resistant apron, protective eyewear and a head covering should be worn. Pant legs should be worn outside boots, and sleeves should be worn outside gloves to prevent the chemical from running down pant legs and sleeves onto legs and arms.

After preparation, chlorine solutions gradually lose their strength. The loss of strength is greater at warmer temperatures, so chlorine solutions should be stored in covered containers at room temperature or slightly cooler. Solutions should be used within 24 hours of preparation for maximum effectiveness. A chlorine stri[illegible] meter can be used to check the chlorine concentration level.

## S3.5 Seed Disinfection - Chlorine

Use of calcium hypochlorite at 20,000 ppm on seed intended for sprouting is recommended by the United States FDA. In Canada, Health Canada allowed use of a 2,000 ppm chlorine level several years ago. However, this policy is currently under review, meaning that there is no recommended level in Canada at this time.

Sanitizer strength will depend on the type of seed being treated. The germination rate of some seeds is more sensitive than others (e.g., mung beans are more adversely affected by high disinfectant concentrations than is alfalfa). Scarified alfalfa seed is generally considered to be the most difficult seed to effectively sanitize because of the large number of surface cracks and crevices.

As during seed prewashing, clean equipment and potable water should be used for seed treatment to avoid further seed contamination. The container to be used for seed treatment should be large enough to hold sanitizer, seed, and water, and allow space for thorough mixing to take place without splashing.

Each sprout producer should decide which antimicrobial to use and the concentration at which to use it. If a chlorine sanitizer (65 per cent) is chosen, a producer may use the following formula to prepare the desired chlorine concentration in the quantity of water required.

**Calculation** for different solution strengths using chlorine (65 per cent) in 25 L water

$$\frac{\text{(desired ppm of chlorine)} \times \text{(total water volume)}}{\text{(\% hypochlorite)} \times (10{,}000)} = \text{kilograms of calcium chlorine}$$

e.g., $\frac{\mathbf{(2{,}000\ ppm)} \times (25\ \text{litres})}{(65\%) \times (10{,}000)} = \frac{50{,}000}{650{,}000} = 0.077$ kg or 77 g chlorine needed

e.g., $\frac{\mathbf{(5{,}000\ ppm)} \times (25\ \text{litres})}{(65\%) \times (10{,}000)} = \frac{125{,}000}{50{,}000} = 0.192$ kg or 192 g chlorine needed

e.g., $\frac{\mathbf{(20{,}000\ ppm)} \times (25\ \text{litres})}{(65\%) \times (10{,}000)} = \frac{500{,}000}{650{,}000} = 0.769$ kg or 769 g chlorine needed

**Example of Calculations**

e.g., $\frac{\mathbf{(200\ ppm)} \times (25\ \text{litres})}{(5.25\%) \times (10{,}000)} = \frac{5{,}000}{52{,}500} = 0.095$ l or 95 ml chlorine needed

or more simply, mix 4 ml of *household bleach (5.25%) in 1 L of water

e.g., $\frac{\mathbf{(2{,}000\ ppm)} \times (25\ \text{litres})}{(5.25\%) \times (10{,}000)} = \frac{50{,}000}{52{,}500} = 0.95$ l or 950 ml chlorine needed

or more simply, mix 40 ml of household bleach (5.25 per cent) in 1 L of water

*** Note: Some commercially available household chlorine bleaches contain fragrances, thickeners and/or other additives not approved for food use. These products are not suitable for sanitizing solutions.**

- Use large volumes of sanitizer solution to maximize the opportunity for seed surface/sanitizer contact. For example, at least 25 L of chlorine solution should be used for 5 kg of prewashed seed.

- Stir the seed/chlorine solution carefully, but thoroughly, for 15 minutes to maximize seed/chlorine solution contact.
- After treatment, dilute the chlorine solution with water then drain.
- Handle treated seed in a sanitary manner to ensure that it will not become recontaminated.

This last point requires further explanation. Chemical sanitizers reduce not only pathogen populations, but also the level of other bacteria. This reduction in bacterial competition allows newly introduced bacterial pathogens (e.g., as a result of recontamination) to multiply rapidly, which could potentially nullifying the initial benefit.
Commercial test kits are available to measure chlorine concentrations. They should be used to verify that the concentration is correct. All measurements should be recorded.

Sanitizer solution loses its effectiveness during use and should be discarded after each batch of seed. New sanitizer solution should be prepared for each new batch of seed.

Some scientists and some growers believe that disinfecting seed lowers (but does not eliminate) pathogens to levels that cannot be detected during spent irrigation water testing. Others argue that, given the short generation time of pathogens, detectable population levels are reached before spent irrigation water is collected after 48 hours of growth. For example, the *E. coli* population doubles approximately every 20 minutes under optimal growth conditions. This means the *E. coli* population could potentially double 144 times before the irrigation sample is collected (e.g., 1 pathogen, under optimal conditions, potentially could multiply to $2.23 \times 10^{43}$ pathogens in 48 hours.) The doubling time for *Salmonella* is estimated at 20 to 30 minutes.

## S3.6 Residue Rinse

In the same way that it was necessary to initially remove dirt and debris from seed, it is necessary to remove excess chemical residues from the seed. This step is especially important for organic growers that have chosen to use a chemical sanitizing treatment.

Sufficient volumes of potable rinse water should be used so there is full contact with every seed. Rinse treated seeds thoroughly for at least 10

minutes. Change the water several times to ensure as complete removal of chemical residues as possible. Regardless of amount of rinsing, there is evidence that a certain amount of chlorine reacts with the seed coat and is not easily removed.

All equipment (containers, sieves, handling equipment, etc.) should be clean and sanitized before use, and only potable water should be used to prevent recontamination of the seed.

After all disinfection steps have been completed, seed should be handled carefully to avoid seed recontamination by containers, equipment, employees, airborne dust, water or pests before sprouting begins.

## S3.7 Chlorine Disposal

Chlorine solutions are neutralized by oxidizing reactions with air, sunlight, organic and inorganic substances.

Diluted chlorine solutions released into sanitary sewers react with inorganic and organic pollutants in sewage so chlorine is rapidly neutralized.

Chlorine solutions should not be released into storm sewers. Impurities found in storm water may not be sufficient to completely neutralize chlorine. Storm sewers often discharge directly into streams or lakes where chlorine can be highly toxic to aquatic species.

Do not discharge chlorine solutions into sewage lagoons or into septic tanks where they may kill the bacteria that are actively working to break down the raw sewage. Never dump chlorine solutions directly into streams, rivers or lakes where they can kill fish and other aquatic life.

## Table 2 Chemical and Physical Interventions for Reducing Pathogens on Inoculated Sprouting Seed*

| Treatment | Conditions | Time | Seed Type | Bacterium | Logarithmic Reduction - Colony Forming Units per Gram (CFU/G) | Seed Germination | Refs. |
|---|---|---|---|---|---|---|---|
| Acetic acid, vapor | 242 μl/L air, 45°C | 12 h | Mung bean | *Salmonella* | > 5, no survivors | No effect | 54 |
| Acetic acid, vapor | 242 μl/L air, 45°C | 12 h | Mung bean | *E. coli* O157:H7 | > 6, no survivors | No effect | 54 |
| Acetic acid, vapor | 242 μl/L air, 45°C | 12 h | Mung bean | *L. monocytogenes* | 4.0 | No effect | 54 |
| Acetic acid, vapor | 300 mg/L air, 50°C | 24 h | Alfalfa | *Salmonella* | 0.8 | No effect | 55 |
| Acidic EO water | 1,081 mV, 84 ppm chlorine | 10 min | Alfalfa | *Salmonella* | 1.5 | No affect | 56 |
| Acidic EO water | 1,150 mV, 50 ppm chlorine | 64 min | Alfalfa | *E. coli* O157:H7 | 1.6 | Significant reduction | 57 |
| Acidic EO water | 1,079 mV, 70 ppm chlorine | 15 min | Alfalfa | *Salmonella* | 2.0 | No effect | 58 |
| Allyl isothiocyanate | 50 μl/950-cc jar, 47°C | 24 h | Alfalfa | *E. coli* O157:H7 | >2.0, survivors present | Slight reduction | 59 |
| Ammonia, gas | 300 mg/L | 22 h | Alfalfa | *Salmonella* | 2.0 | No effect | 60 |
| Ammonia, gas | 300 mg/L | 22 h | Mung bean | *Salmonella* | 5.0 | No effect | 60 |
| Ammonia, gas | 300 mg/L | 22 h | Alfalfa | *E. coli* O157:H7 | 3.0 | No effect | 60 |
| Ammonia, gas | 300 mg/L | 22 h | Mung bean | *E. coli* O157:H7 | 6.0 | No effect | 60 |
| $Ca(OH)_2$ (Calcium Hydroxide) | 1% | 10 min | Alfalfa | *E. coli* O157:H7 | 3.2 | | 61 |
| $Ca(OH)_2$ | 1% | 10 min | Alfalfa | *Salmonella* | 2.8 – 3.8 | No effect | 61, 62 |
| $Ca(OCl)_2$ (Calcium Hypochlorite) | 20,000 ppm | 3 min | Alfalfa | *E. coli* O157:H7 | > 2.3, survivors present | Reduced rate | 63 |
| $Ca(OCl)_2$ | 20,000 ppm | 10 min | Alfalfa | *Salmonella* | 2.0 | Slight reduction | 62 |
| $Ca(OCl)_2$ | 18,000 ppm | 10 min | Alfalfa | *Salmonella* | 3.9 | No effect | 64 |
| $Ca(OCl)_2$ | 18,000 ppm | 10 min | Alfalfa | *E. coli* O157:H7 | 4.5 | No effect | 64 |

| Treatment | Conditions | Time | Seed Type | Bacterium | Logarithmic Reduction - Colony Forming Units per Gram (CFU/G) | Seed Germination | Refs. |
|---|---|---|---|---|---|---|---|
| $Ca(OCl)_2$ | 16,000 ppm | 10 min | Mung bean | *Salmonella* | 5.0 | No effect | 65 |
| $Ca(OCl)_2$ | 16,000 ppm | 10 min | Mung bean | *E. coli* O157:H7 | 3.9 | No effect | 65 |
| Chlorine dioxide, acidified | 500 ppm | 10 min | Alfalfa | *E. coli* O157:H7 | >2.4, survivors present | Significant reduction | 63 |
| Citrex™ | 20,000 ppm | 10 min | Alfalfa | *Salmonella* | 3.6 | No effect | 66 |
| Citrex™ | 20,000 ppm | 10 min | Alfalfa | *E. coli* O157:H7 | 3.4 | No effect | 66 |
| Dry heat | 50 C | 60 min | Alfalfa | *E. coli* O157:H7 | 1.7 | No effect | 67 |
| Dry heat | 70 C | 3 h | Alfalfa | *Salmonella* | 3.0 | Slight reduction | 55 |
| Fit™ | According to label | 15 min | Alfalfa | *Salmonella* | 2 | No effect | 68 |
| Fit™ | According to label | 15 min | Alfalfa | *E. coli* O157:H7 | >5.4 | No effect | 68 |
| $H_2O_2$ | 8% | 3 min | Alfalfa | *E. coli* O157:H7 | >2.9, survivors present | No effect | 63 |
| $H_2O_2$ | 8% | 10 min | Alfalfa | *Salmonella* | 3.2 | No effect | 62 |
| Hydrostatic pressure | 300 mPa | 15 min | Garden cress | *Salmonella* | 5.8 | Reduced rate | 69 |
| Hydrostatic pressure | 300 mPa | 15 min | Garden cress | *Shigella flexneri* | 4.5 | Reduced rate | 69 |
| Lactic acid | 5%, 42°C | 10 min | Alfalfa | *E. coli* O157:H7 | 3.0 | No effect | 51 |
| Radiation, gamma | Various | | Alfalfa | *Salmonella* | D-value of 0.97 kGy | Dosage dependent | 70 |
| Radiation, gamma | Various | | Alfalfa | *E. coli* O157:H7 | D-value of 0.60 kGy | Dosage dependent | 70 |
| Radiation, gamma | Various | | Broccoli | *Salmonella* | D- value of 1.10 kGy | Dosage dependent | 71 |
| Radiation, gamma | Various | | Broccoli | *E. coli* O157:H7 | D- value of 1.11 kGy | Dosage dependent | 71 |
| Sodium chlorite, acidified | 1,200 ppm, 55°C | 3 min | Alfalfa | *E. coli* O157:H7 | >1.9, survivors present | Slight reduction | 63 |
| Sulfuric acid | 2 N | 20 min | Alfalfa | *E. coli* O157:H7 | 5.0 | No effect | 72 |
| Ozone, aqueous | 21 ppm, w/sparging | 64 min | Alfalfa | *E. coli* O157:H7 | 2.2 | No effect | 73 |
| Ozone, aqueous | 21.3 ppm, w/sparging | 20 min | Alfalfa | *L. monocytogenes* | 1.5 | No effect | 74 |

| Treatment | Conditions | Time | Seed Type | Bacterium | Logarithmic Reduction - Colony Forming Units per Gram (CFU/G) | Seed Germination | Refs. |
|---|---|---|---|---|---|---|---|
| Pulsed UV light | 5.6 J/cm2, 270 pulses | 90 sec | Alfalfa | *E. coli* O157:H7 | 4.9 | Significant reduction | 75 |
| Dielectric heating, radio frequency | 39 MHz, 1.6 kV/cm | 26 sec | Alfalfa | *Salmonella* | 1.7 | No effect | 76 |
| Supercritical $CO_2$ | 4,000 psi, 50 C | 60 min | Alfalfa | *E. coli*, generic | 1.0 | No effect | 77 |
| Water, hot | 3-stage: 25 to 50 to 85°C | 30 min, 9 sec, 9 sec | Alfalfa | *E. coli*, generic | >4, no survivors | No effect | 78 |
| Water, hot | 54°C | 5 min | Alfalfa | *Salmonella* | 2.5 | No effect | 33 |
| Water, hot | 80°C | 2 min | Mung bean | *Salmonella* | >6 | No effect | 79 |

* Table courtesy of Dr. William Fett, USDA, ARS, Wyndmoor, Pennsylvania. For further information, please refer Chapter 8, Interventions to Ensure the Microbial Safety of Sprouts, *Microbiology of Fruit and Vegetables*, published by CRC Press, Taylor & Francis Group, 6000 Broken Sound Parkway NW, Suite 300, Boca Raton, Florida 33487-2742 ISBN 0-8493-2261-8 www.crcpress.com

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## S4 SEED GERMINATION

### S4.1 Pregermination Soak

After seed disinfection, seed should be handled in a sanitary manner to prevent recontamination. Pathogens can be reintroduced by dirty equipment and/or utensils and/or water and/or unsanitary handling practices.

Chemical disinfection reduces not only pathogen populations, but also the other non-harmful bacteria populations. This reduction in competition allows any newly introduced pathogens (e.g., as a result of cross-contamination) to multiply rapidly, which can nullify the initial benefit of seed disinfection.

To initiate sprouting and to encourage good germination, seeds are generally presoaked in potable water before being placed on germination trays or in drums. All containers used for soaking should be constructed of food-grade material and should be cleaned and sanitized prior to use (see Section O3 Sanitation).

It is also important that the water delivery system is sanitary. This requires regular cleaning and sanitation of the interior of taps and hoses, as well as screens, aerators, etc. attached to taps. Flush out the system by allowing water to run full force before using. Water should cover all seed during soaking. Some growers include a low level of disinfectant/sanitizer in the seed soak water.

Following the soak, seed should be thoroughly rinsed with potable water to remove chlorine or other residues that may remain.

Utensils and equipment used to transfer and hold seeds should not be used for other purposes. After cleaning and sanitizing, they should be stored in a clean, sanitary area separate from utensils and equipment used for other purposes.

### S4.2 Germination

The germination room, equipment and utensils should be cleaned, sanitized, and rinsed before each germination lot/production cycle to reduce the potential for contamination. Section O3 discusses cleaning and

sanitation in detail. As noted in Section E4.1 Equipment Maintenance, ease of cleaning should be a major consideration when purchasing new equipment.

Irrigation water pouring onto the floor can create aerosol-borne bacteria that can spread human and plant pathogens. It is important that seed trays are located at a height low enough to prevent creation of aerosols but high enough to avoid backsplash off the floor. Rotary drums, which are higher off the floor, should have a water catch tray with a hose that leads to a drain.

Hygienic handling of germinating seed is also critical in preventing contamination. Section O1 Personnel Practices, outlines personnel requirements. All should be followed. Use of sanitary gloves is essential when handling seed or sprouts.

As noted in Section E3.1 Internal Structures and Fittings, germination should take place in a room or area separate from other operations of the facility. The room interior should be constructed of durable materials and be easily cleanable. Equipment should be constructed of food-grade materials (e.g., stainless steel or food-grade plastic). Human and equipment flow should be carefully controlled to prevent cross-contamination. The ventilation system should supply a sufficient volume of clean, uncontaminated air. (Air quality and ventilation are discussed in Section E3.4.) Freestanding water can also be a source of contamination and should be minimized by effective drainage.

Although most sprouts are grown hydroponically, sometimes soil or a soil-less mixture is used as the growth medium. Where a growth medium is used, the sprouts are "clean" but the soil is not. Therefore, in facilities where both methods are used, soil and hydroponic sprouts should be grown in separate rooms. Separate equipment and tools should be used in both rooms. Personnel should change clothing and footwear when moving from one room to the other to reduce the risk of cross-contamination.

Regardless of the growing method (soil or hydroponically) or the equipment used (trays, bins or rotary drum), once a sprout crop is started, it should be fully harvested and the room and equipment cleaned and sanitized before new seeds can be introduced. For example, if there is an empty space on a rack, a new seed tray should not be placed in that empty

spot while already established sprouts are growing above or below it. The same applies to empty quadrants in rotary drums.

In both hydroponic and soil-based operations, seed should be transferred to sanitary drums, bins, or trays using food-grade, sanitized, dedicated equipment. Personnel should follow hygienic food handling practices. Utensils and equipment used to transfer and hold seeds should not be used for other purposes.

There are conflicting views on whether soil used as the growth medium should be sterilized or not. Supporters suggest that sterilization before use eliminates the soil's potential pathogens. Critics claim that their research shows that, while there is a greater risk of pathogens affecting the plants themselves, the natural microflora found in soil reduces the growth of the human pathogens *E. coli* and *Salmonella*.

Sterilized potting soil may be used but composted manure should not. Previously used soil returned to the sprouting facility should be composted and sterilized if it is to be reused. Generally, this practice is not recommended.

Only potable water should be used for sprout irrigation. Water is often held in tanks within the facility until it reaches room temperature. These holding tanks, along with irrigation systems, should be periodically swabbed and tested for the presence of pathogens. The system also should be regularly shocked with chlorine. In extreme cases, the system may require flushing with a sanitizing solution or disassembly for inspection, thorough cleaning and sanitation.

Although rare in smaller operations, there is increased interest in recycled irrigation water due to the high cost of using large quantities of municipal water. This may be a dangerous practice; pathogens washed out of the sprouts may contaminate or recontaminate during later irrigation cycles. Great care should be taken in the design and use of a water recycling system. The use of homemade recycling systems is strongly discouraged. Commercial water recycling systems are available (e.g., www.sproutnet.com/Encore_bean_sprout_water_recycler.htm). Regardless of the system employed, it should be meticulously monitored and maintained to prevent sprout contamination or recontamination.

## S4.3 Spent Irrigation Water Testing

As described in Section S2.1, prior to germination, seed samples should have been inspected and tested. Many growers also use some form of seed disinfection (described in Section S3). Even when these precautions have been taken, as a further safety verification measure, growers should also test spent irrigation water for pathogens during the germination cycle.

Spent irrigation water samples should be collected approximately 48 hours after the initiation of sprouting when pathogen levels (if there are any) are likely to be at detectable levels. The research suggests that there is no increased benefit to testing later than 48 hours after germination. This timing will allow the lab test results to be known before the sprout crop is harvested. This allows growers to destroy the crop if necessary before it is distributed.

The same advice given in Section S2.7 for interpreting microbial test results from spent irrigation water from seed samples also applies here. It is of such importance that it is repeated below.

Regardless of the tests employed, all test results should be interpreted with caution.

When test results are negative, the results are assumed to be correct. However, a negative result does not guarantee that there is no *E. coli* O157:H7 and/or *Salmonella* on the seed. Pathogens still may be present; they just were not found. From a legal standpoint, testing does provide evidence of due diligence on the part of the sprout producer.

**If the seed lot sample tests positive for generic *E. coli* and/or *Salmonella*, the test should be presumed to be correct** (presumptive positive) and it is assumed that the seed is contaminated. At this point, the grower has two options.

Option 1: Agree that the seed is contaminated and not use it for sprouting. Destroy the crop before any more time and resources are used, before these sprouts further contaminate other production batches and before it enters the food supply.

Option 2: Hold the crop and request a confirmatory test (or tests) from

the enriched culture of the original spent irrigation water sample to determine if *E. coli* O157:H7 and/or *Salmonella* are indisputably present. This can be confirmed by biochemical (i.e., MFHPB-19) or genetic methods. If the confirmatory tests are **negative**, the seed may be considered free of *E. coli* O157:H7 and/or *Salmonella* and used for sprouting.

If the confirmatory test is **positive** for pathogens, the grower can destroy the crop before it is sold for human consumption.

Although retesting is routine in the food industry, it may be wise for sprout growers not to follow this practice. A negative result during a second series of tests may lead the grower to falsely conclude that the seed is safe when, in fact, it is not. The most prudent choice is to accept the initial finding rather than trying to prove that it is incorrect.

Food safety experts suggest that testing spent irrigation water from commercially grown sprouts is an appropriate tool to verify earlier seed sample irrigation water testing results. Ideally, the decision to release sprouts for sale should be based on the results of both the preproduction seed sample irrigation water testing and irrigation water screening from sprout production.

Refer to Sections S2.6 and S2.7 for a full discussion of collecting and testing spent irrigation water.

Pending negative irrigation water test results from the sprouter's in-house or outside laboratory, the sprouts being tested should not be released for sale by the sprout grower.

Growers may be tempted to dip into their "held" sprouts for a number of reasons (larger orders than expected, low yields, irrigation water samples were late getting to the lab, the lab is late returning results, etc.). While a grower may be able to rationalize this action from a short-term business perspective, the long-term implications are frightening.

If positive results for pathogens are received after the sprouts have been shipped, the grower should:

- Immediately notify the CFIA at (416) 973-8724 (see Section O6 Recall).

- Take steps necessary to immediately recall that lot of sprouts (see Section O6 Recall).

Growers that find that "no lab result" sprouts are being shipped may wish to consider reducing the time period before testing the irrigation water. Although 48 hours is ideal and growers should strive to use it, a 24 to 36 (only if 24 to 36 hours is sufficient to produce reliable results)–hour testing program creates flexibility and is far less risky than releasing sprouts for which there are no results.

# S5 SPROUT HARVESTING

## S5.1 Harvesting

Equipment and utensils used to harvest sprouts should be constructed of food-grade material and dedicated solely to harvesting sprouts. (Colour-coding is often used to distinguish harvest tools from those used for other purposes.) Harvesting tools should be cleaned and sanitized after use then stored in a sanitary environment (e.g., off the floor, away from production or cleaning activities) to prevent contamination.

Harvesting personnel should wear appropriate clothing and follow hygienic handling procedures (see Section O1 Personnel Practices). Sprouts should never be handled with unsanitary hands or gloves.

Transportation bins or belt systems should be clean, sanitary and constructed of food-grade material. Some bean sprout growers use portable bins to first germinate and then transport their sprouts. This not only eliminates the potential for contamination from transportation devices but also makes cleaning and sanitizing the growing rooms and bins easier and more effective. Portable growing trays and racks can be used in a green sprout operation for the same purpose.

When possible, sprouts grown in soil trays should be harvested in an area separate from that used to harvest hydroponic sprouts. However, to prevent cross-contamination when both are harvested in the same area, washing, drying, and packing areas, and all food contact surfaces, should be thoroughly cleaned and sanitized between each batch of sprouts.

Soil-grown sprout trays should be kept off food contact surfaces during harvest. Gloves or harvest utensils that contact the soil should be immediately cleaned and sanitized before their use continues. As the sprouts are harvested, they may be rinsed under potable running water. Excess water should be removed before packaging.

## S5.2 sprout Rinse

As a seed sprouts, it sheds its hull. However, in some types of sprouts, the hull tends to remain attached to the growing sprout. With some exceptions, green sprouts generally do not go through a hulling process. However, hull

removal is important to mung bean sprout growers. Not only is the hull unappealing to consumers but, being dead, it will begin to decay if the sprout is not properly refrigerated. Decay lowers sprout quality and acts as a potential source of microbial contamination.

Many sprout growers rinse newly harvested bean sprouts in cold water. In addition to removing excess hulls, the cool water begins to lower sprout temperature, which reduces the rate of microbial growth and that, in turn, helps maintain sprout quality. (Cold water is more effective than cold air in removing heat from harvested sprouts.) This wash water may contain low levels of chemical sanitizer (e.g., chlorine). Washing and rinsing may reduce microbial contamination of sprouts by up to 1 $\log_{10}$.

Bean sprouts are transferred from transport bins into the wash tank of cool potable water either manually with a stainless steel or food-grade plastic fork or automatically with a more sanitary mechanical bin dumper. As they are being washed by agitated water, the sprouts are moved through rotating fingers which help to remove the hulls. All equipment should be constructed of food-grade material.

When a water bath is used, wash water can become a reservoir of microorganisms that may include pathogens. These pathogens may be transferred to previously pathogen-free sprouts in the tank. As the organic matter content (e.g., seed hulls) of the water increases, sanitizers (such as chlorine) quickly lose their ability to kill pathogens. To maintain water cleanliness and sanitizer effectiveness, rinse water should be changed frequently during washing and always between batches.

Regardless of how the sprouts are hulled and washed, excess moisture, which can reduce shelf life significantly, should be removed. This can be accomplished by a centrifuge, high-velocity air jet or shaker table. Whatever drying method is used should be gentle enough to avoid damage to the sprouts. Damage compromises sprout safety, quality and shelf life.

No matter the method of hulling and drying, all equipment, utensils, and food contact surfaces should be constructed of food-grade materials and should be cleaned and sanitized between each batch of sprouts. Personnel should be properly outfitted and always follow hygienic handling procedures (refer to Section O1 Personnel Practices).

## S5.3 Post-Harvest Cooling

Following harvest, sprouts continue to be living, respiring plants that are highly perishable. Rapid cooling and relatively low storage temperatures sharply decrease the respiration rate and the potential for microbial growth (including pathogens, if they are present).

Sprouts that are packaged immediately after harvest should be cooled without delay. When sprouts, for whatever reason, are not packaged immediately after harvest, they should be refrigerated promptly to decrease their respiration rate and the potential for microbial growth.

Cooler temperatures should be kept between 0 and 4°C at a relative humidity of 95 per cent or greater.

Shallow, open containers cool most quickly. However, covers add necessary protection against physical, chemical and biological contamination. Ventilated covers and adequate space between containers, the floor, and walls allow free airflow and speed cooling.

Soil-grown sprouts are sometimes shipped to buyers still in their growing trays. To prevent the soil from physically contaminating the sprouts in other trays, trays should be loosely covered as they are placed in the cooler and during transportation.

Storage practices are discussed in greater detail in Section S6.5.

## S6 PACKING and STORAGE

### S6.1 Types of Packaging

A variety of packaging and packaging materials may be used for sprouts.

From a food safety perspective, sprouts should be packaged in such a way that:

- They are protected against physical damage.
- They are protected against chemical and biological contamination.
- They are easily cooled.
- The packages are convenient for transportation and distribution.

Even after harvest, sprouts are still respiring (living) plants producing heat and gaseous byproducts. Packaging should allow the sprouts to continue to live, and refrigeration slows the rate of respiration significantly. Scientific studies indicate that the combined use of appropriately perforated packaging and correct cold chain management creates the longest shelf life.

Clear plastic “clamshell” or “lidded” containers with perforations for ventilation and drainage are commonly used to package “green” sprouts. They help protect against external biological, physical, and chemical contamination, and preserve quality and safety by dispersing heat and gaseous waste and allowing sprouts to respire. When secondarily packed in a cardboard box, they are also protected against physical damage encountered during handling and transport.

Two types of food grade plastic bags are also used; those with and those without holes. Impermeable (hole-less) bags create an internal anaerobic (oxygen-free) atmosphere over time that decreases shelf life significantly as the sprouts respire. A wide variety of “breathable” micro-perforated plastic bags are permeable to controlled rate of oxygen flow. They offer protection against external contamination but still allow the sprouts to respire, thus prolonging their shelf life. To ensure protection against storage, handling and transportation damage, plastic bags should be packed in a secondary container.

“Breathability” of plastic bags is measured by the Oxygen Transmission Rate (OTR). The OTR is measured as the number of cubic centimetres of oxygen that pass through a square metre of packaging in a 24-hour period

($cc/m^2/24$ hr). This type of packaging is available in a wide range of transmission rates to accommodate different products, the relative humidity of the product and storage temperatures.
Vendors of plastic bags should be able to provide sprout growers with the technical expertise necessary to make the correct selection for their packaging requirements.

Some sprouters use wax-coated cardboard boxes to package sprouts. The cardboard resists water and physical damage, while small holes eliminate excess moisture and allow airflow. Sprouts can be packed directly into the box with or without a liner. Wax-coated boxes should not be reused.

New cardboard boxes are also used as sprout containers. However, because they are not water resistant, food grade polyethylene box liners should be used. As described above, these liners should be micro-perforated to allow gas exchange.

Sprouts are sometimes packaged and shipped in reusable plastic totes. Once empty, the totes are returned to the grower where they are cleaned and refilled. Sprouters should be very careful to thoroughly clean and sanitize reusable plastic totes before they are refilled. This requires proper cleaning and sanitation procedures. To prevent potential cross-contamination, tote cleaning should be done in an area separate from other plant activities (e.g., production, packaging, etc.).

Even when totes are clean, an additional safeguard will help ensure their safety. Sprouts should be packaged in breathable food grade plastic liners placed inside the reusable totes. This is now an industry standard in Ontario. Plastic liners with the correct oxygen transmission rates for the storage temperature and humidity should result in a minimal reduction in sprout shelf life and quality. In addition, the sprouts will have increased protection against external contamination (e.g., when filled totes are stacked on top of each other).

Sprouts grown in soil are sometimes shipped to buyers still in their growing trays. These trays should be placed inside micro-perforated plastic bags if the bags are to be closed. When bags are left open, impermeable plastic may be used. However, open bags are susceptible to external contamination and may themselves be a source of contamination to other open bags.

To further protect the safety of packaged sprouts, tamper-evident closures should be used on all packaging.

No matter which type of packaging is used, it should be food grade. CFIA's *Reference Listing of Accepted Construction Materials, Packaging Materials and Non-Food Chemical Products* (www.inspection.gc.ca/english/fssa/reference/refere.shtml) lists acceptable packaging. If the packaging material is not listed, it requires a letter of "No Objection" or an acceptance letter from Health Canada. Packaging should be stored in a clean, dry, pest-free environment separate from all other sprouting activities.

## S6.2 Package Sanitation

New sprout packaging is manufactured from food-grade materials, quality inspected and shipped in sealed packaging to prevent contamination. As retail containers leave the manufacturer, they are clean, sanitary and ready to be filled without washing. If packaging remains intact during transit and storage, containers are still clean, sanitary and ready to be filled without washing. However, this does not eliminate the need for visual inspection before filling.

Packaging that is damaged at the time of delivery should be clearly identified and set aside until it can be returned to the manufacturer. If reported immediately, the manufacturer/vendor will often replace the damaged and/or contaminated containers at no cost. Manufacturers/vendors may not replace packaging that is damaged by rough handling and/or contaminated by rodents or other sources of contamination while being stored by a producer.

Boxes of new retail packaging should be turned upside down and opened from the bottom so the containers are upside down in the box. That upside-down position should be maintained until the time of filling to prevent contamination with foreign material such as dust or rodent droppings. The smallest residue or contaminant can create a food safety risk and/or quality issues.

As described in S6.1, returned reusable plastic totes (or containers or bins) should be cleaned and sanitized before being refilled. Cleaning and sanitation should take place in an area separate from storage, growing and

packing activities. Section O3 describes cleaning and sanitation procedures in detail. Following sanitation, totes should be placed upside down to air dry. Sanitized totes (or containers or bins) should never be placed directly on the floor where they can easily be recontaminated.

At some point, the reusable totes will become scuffed and/or scratched so badly that they will be difficult or impossible to adequately clean and sanitize. At this point, these totes should be removed from use.

## S6.3 Packaging Area

Packaging should take place in an area separate from all other sprout facility operations. A discussion of the area design and construction may be found in Section 3 E3.

General standards for equipment design, construction and maintenance are described in Section 3 E4.1. Utensils and equipment used for packaging should be clearly identified so their use is restricted to packaging operations.

Dirty skids and/or unclean reusable plastic totes should be kept out of the packaging area where they may introduce contamination. For the same reason, pallet trucks and other equipment used to transport washed sprouts or finished product should not be allowed to track dirt or carry potential contaminants into the area.

## S6.4 Packaging Operations

After harvest, sprouts should be packed immediately. If a delay of one hour or more is anticipated, the sprouts should be placed in refrigerated storage at temperatures between 0 and 4°C. The more quickly sprouts are refrigerated, the less opportunity for microbial growth (including pathogens, if they are present). Low pathogen populations mean safer sprouts. Lower microbial populations mean better quality sprouts.

While sprouts may be packed automatically, many sprouts are packed manually.

Automatic weighing and packing minimizes the need for human contact with the sprouts. Theoretically, clean, sanitized, properly designed and constructed automatic equipment should create a lower likelihood of microbial contamination than manual packing. However, when adequate sanitation and handling procedures are in place, both manual and automatic methods can be effective.

Personnel involved in packaging operations should be correctly outfitted and follow the hygienic handling procedures outlined in Section O1.1, Personnel Hygiene/Practices. This includes wearing impermeable aprons and gloves and wearing hair/beard covering.
Workers handling secondary packaging such as returnable plastic totes or cardboard boxes should not touch sprouts unless they wash their hands and change into clean gloves.

Packaging should never be placed directly on the floor, either before or after use. Primary packaging such as plastic clamshells, lidded containers or plastic bags should always be placed on food contact surfaces. Clean, off- the-floor surfaces may be used for secondary packaging such as cardboard boxes and reusable plastic totes. To minimize the opportunity for contamination, no packaging of any type should be placed on exposed sprouts. This means that sprouts packed in reusable plastic totes without plastic liners should never be stacked one on top of the other.

To maintain sanitary conditions, sprout debris should be continuously cleaned from packing lines, utensils and floors. Pay special attention to areas where trapped sprout debris can create ideal growing conditions for microorganisms. Where water under pressure is used for cleanup, care should be taken to avoid creation of oversprays or aerosols that can contaminate the sprouts, sprout contact surfaces or packaging. As a minimum, equipment should be cleaned and sanitized after each batch of sprouts is packed. Cleaning and sanitation practices are described in Section O3.

## S6.5 Storage

Compared to many fruits and vegetables, the respiration rate of sprouts is high. Generally, the higher the rate of respiration, the more perishable the product. The rate of respiration increases significantly as storage temperature increases, resulting in a decrease in sprout shelf life.

Proper cold chain management is essential to maintain the safety and quality of sprouts. According to the USDA *Agricultural Handbook Number 66* (www.ba.ars.usda.gov/hb66/128sprouts.pdf), holding temperatures have a dramatic impact on the maximum saleable life of mung bean sprouts.

| Holding Temperature | Maximum Saleable Life |
|---|---|
| 2.5°C | 5.5 days |
| 5.0°C | 4.5 days |
| 10.0°C | 2.5 days |

Source: "Sprouts" from the USDA *Agricultural Handbook Number 66.* Author: Jennifer R. DeEll. Ontario Ministry of Agriculture and Food, Simcoe, Ontario.

Once harvested, sprouts should be refrigerated to temperatures between 0 and 4°C. These temperatures should be reached as quickly as possible to slow microbial growth (including pathogens, if they are present). A relative humidity of 95 to 100 per cent is ideal. For mung beans, the cooler should be dark to discourage chlorophyll development, which causes greening of the bean sprouts.

To minimize the buildup of heat created by the respiration process, good air circulation around the containers is essential. Leave space between pallets of containers and between pallets and cooler walls. Do not stack containers or pallets of containers too high. Overfilling the cooler will slow cooling dramatically.

In the absence of an automatic temperature recorder, storage temperatures should be monitored and recorded at least twice daily. It should be noted that product temperature is a more accurate measure than is air temperature. Product in the centre of the room will be the slowest to cool. Continuous temperature monitoring and recording devices eliminate the need for manual temperature monitoring. Often, they are equipped with warning devices in the event the temperature falls outside the desired or "safe" range.

Portable thermometers should be checked regularly for accuracy. One way to do this is with a container of ice water. When stirred, both the ice and the water are at an equilibrium temperature of 0°C. Place thermometers in the ice water and note any variations from that temperature. Inaccurate thermometers should be recalibrated or discarded.

Where a fixed thermometer is used (e.g., in coolers), a second, regularly calibrated portable thermometer should be used to periodically check the accuracy of the fixed thermometer. In the event of discrepancy, the fixed thermometer should be replaced.

Section O2, Shipping, Receiving, Handling and Storage, describes general storage practices in greater detail.

## S6.6 Offsite Packaging

Sprouts are sometimes shipped in bulk to supermarkets or farmers' markets where customers package the sprouts themselves or the sprouts are packaged by the vendor. In these less controlled situations, there is much greater potential for sprout contamination.

Warm temperatures encourage bacterial growth. Supermarkets usually have refrigerated displays, but those open enough to accommodate self-serve may not be able to maintain temperatures between 0 and 4°C. This compromises sprout safety and quality. In addition, the open nature of the display greatly increases the potential for external physical, biological and chemical contamination. The most notable of these is biological contamination caused by unsanitary handling practices by customers. This may include unclean bare hands, open wounds on hands coming in contact with the sprouts, or coughing or sneezing over the sprouts.

Supermarkets should maintain the cold chain in displays. Clean, sanitary utensils should be available for transfer of sprouts from the bulk container to the consumer container. A sign outlining safe handling procedures may be posted, as well.

Safe display of sprouts at farmers' markets is more problematic. Uncontrollable conditions such as lack of refrigeration and/or exposure to the hot sun make sprout safety difficult to maintain. In the absence of refrigerated units, ice beds may be considered as an alternative cooling method. Sprout containers should not be placed in the sun or directly on the ground, and they should be protected from potential contaminants falling from rafters and overhangs. Vendors should immediately remove and destroy any potentially contaminated product.

No matter where bulk sprouts are handled (supermarket, farmers' market, or restaurant), clean, sanitary utensils and hygienic practices should always be used.

## S6.7 Label requirements

Labelling must meet regulations of the Consumer Packaging and Labelling Act (http://laws.justice.gc.ca/en/C-38/index.html ), as well as those of the Food and Drugs Act (http://laws.justice.gc.ca/en/F-27/index.html).
A more detailed discussion on label requirements is provided in Section O2.7 Packaging – Label Requirements.

## CONTROL PROGRAMS

**Control programs are developed and updated as required. Each program outlines effective food hygiene policies and procedures to protect the safety and suitability of food. Each program outlines the roles, responsibilities and instructions for each operational area.**

Good Manufacturing Practices (GMPs) are the basic, universal conditions and procedures within the processing establishment that create conditions favourable for the production of safe food. They are the sum of all the programs/policies, practices and procedures that should be applied to reduce contamination risk during sprout production.

### What Is Required?

Every facility should develop **written** policies and procedures for:

- Each specific operational area of:
  - **O1** Personnel practices
  - **O2** Shipping, receiving, handling and storage
  - **O3** Sanitation
  - **O4** Equipment maintenance
  - **O5** Pest control
  - **O6** Recall
  - **O7** Water safety
  - **O8** Traceability (section O10 in *HACCP Advantage Plus+*)
  - **O9** Security (section O1 in *HACCP Advantage Plus+*)

- All food safety–related employee training, as well as specialized technical training for areas such as sanitation, calibration, etc.

Training is addressed in the next section of this Guidebook.

Each written control program should describe the GMP programs/policies and procedures necessary to protect the safety and suitability of food. As an added benefit, detailed procedural and training descriptions help workers to quickly grasp the details of new or temporary assignments by following the written "recipe".

### Operational Controls

Operational control written programs should meet required GMP standards and be suitable for your operation. Those that aren't should be revised until they are. Programs should also include a monitoring component to ensure that the required GMP standards are being met.

These written programs are sometimes referred to as Standard Operating Procedures (SOPs) or Sanitation Standard Operating Procedures (SSOPs). A more detailed explanation on SOPs and an example follows below.

Records offer written proof both that GMP programs are being followed and that those operational processes are under control, thus reducing the probability of contamination. They are your "due diligence". Records also help determine the cause (e.g., the program has not been followed) or rule out the cause (e.g., the program has been followed) of food safety problems, should they occur.

## Environmental Controls

Environmental controls outline requirements of the facility location, design and equipment necessary to create a physical setting for the production of safe food. Because they are not related to people or the actions of people, environmental controls cannot be addressed by a written procedural program. However, redesign, repairs or replacement of buildings and/or equipment can generally correct deficiencies in environmental controls. Without long-term solutions, interim controls may be used to control a hazard for the short term. For example, an employee may use a squeegee to eliminate pooled water from a poorly drained area. Nevertheless, this short-term solution may eventually prove to be less effective and more costly than repairing the floor.

## Standard Operating Procedures (SOPs)

Standard Operating Procedures (SOPs) are written descriptions of specific tasks in a sprout production facility that may or may not be related to food safety. Each SOP should include GMP criteria.

In clear, concise and complete terms, a SOP should address:

- The name/position of the person responsible for carrying out the described activity
- The frequency with which the described activity will be performed
- A step-by-step description of the procedure that includes all the steps involved and their sequence
- The records required to document procedures.

The SOP should also include the person/position writing the SOP, an numbering system (e.g., SOP 1, SOP 2 etc.) and the date the SOP was written (may also include the version number to make it easier to differentiate the most recent edition).

It is important that the procedure described makes it easy to perform the task correctly. If the procedure is difficult to understand, the task is likely to not be consistently done well.

Too often, SOPs are written by "experts" who know how the procedure should be done but fail to consult with those supervising or performing the procedure to discover how the procedure is currently being performed and the capabilities of the existing system and its workers. Therefore, an ideal SOP preparation team includes technical experts, supervisory staff and the people who actually do the work. Together, this team should be able to create a plan that is compatible with other plant operations and meets food safety requirements.

Programs should be reviewed regularly. As conditions change, as more efficient procedures are discovered, as equipment and materials change, as formulations are altered, etc., the SOP should reflect these improvements as the "current best approach." For this reason, the SOP team should meet on a regular basis to review and update the SOP.

A single SOP need not cover every aspect of each operation. It may be divided into components to make it more manageable. For example, although personnel practices, as a group, relate to personal hygiene, a single SOP covering all areas of personal hygiene would be difficult for workers to understand and follow.

**SOP Example**

Every SOP should contain enough detail that an employee will know exactly what to do simply by following the written instructions.

This is an example of a handwashing SOP:

**Responsibility**: *[indicates who is responsible for performing the procedure]*

All those handling food, ingredients, packaging materials and/or touching food contact surfaces.

**Frequency**: *[indicates how often the procedure will be performed]*

Hands should always be washed and clean gloves put on:

- Immediately before handling food, ingredients, and packaging materials, and/or touching food contact surfaces

- After using the toilet
- After coughing, sneezing, blowing or wiping the nose, or touching hair or the face
- After each absence from the work station for coffee breaks and eating
- After handling incompatible food products, raw materials, or potentially hazardous materials such as garbage or cleaning chemicals
- After picking up objects off the floor
- Any other time hands become soiled or contaminated.

**Procedure**: *[describes the specific procedures required to meet the standard]*

- Roll up sleeves far enough so that wrists are exposed and sleeves do not get wet during washing.
- Wet hands and wrists under warm water (38–43ºC).
- Apply a sufficient amount of soap.
- Scrub hands palm to palm. Scrub in, between and around fingers.
- Scrub back of each hand with palm of other hand. Scrub fingertips of each hand in opposite palm. Scrub each hand clasped in opposite hand. Scrub each wrist clasped in opposite hand. Scrubbing should last for a minimum of 15 seconds.
- Rinse hands and wrists thoroughly under warm running water.
- Dry hands well with a single-use paper towel.
- Turn off water tap using the paper towel.
- Put on gloves.
- If gloves have been worn previously, they should also be washed before beginning or returning to their assigned tasks.

**Applicable Records**: *[a record of what took place. "If you don't write it down, it didn't happen."]*

### Sanitation Standard Operating Procedures (SSOPs)

SOPs related to sanitation are called Sanitation Standard Operating Procedures (SSOPs). An SSOP should be specific enough that the sanitation crew can complete each cleaning and sanitation activity simply by following the written instructions. This means that cleaning and sanitation activities will be carried out at the right time and in the right place, in the right order, by using the proper procedures with the right chemicals at the right concentrations. An example of an SSOP may be found in Section O3 Sanitation.

## TRAINING PROGRAMS

**Training is delivered and updated as required to ensure that personnel understand and are competent in the procedures necessary to protect the safety and suitability of food. Training is delivered at an adequate frequency to ensure personnel understanding remains current.**

### Employee Training

The individual contribution of everyone in the sprout production facility is essential to the overall success of any food safety program.

Job-specific training is the process by which workers are:

- Made aware of why correct completion of their individual tasks is so important to food safety
- Informed of their individual roles and responsibilities
- Instructed how to carry out those tasks correctly.

Begin training by emphasizing the relationship between employee tasks and the hazards that can cause foodborne illness. This may include an overview of biological, chemical and physical hazards associated with the sprouts being packed/processed. Employees should be able to easily connect the relevance of what is being presented to the jobs they are being asked to do.

For example, each piece of equipment and/or sanitation task should have a comprehensive, but simply stated, list of procedures that should be followed for cleaning, sanitation, and inspection of walls, equipment, food contact
surfaces, utensils and floors (an SSOP). Training should review these procedures as they relate to the employees being trained. Throughout the training, employees should understand that their contribution to the cleaning and sanitation program is critical to the safety of the sprouts.

Training should also include proper mixing, use, handling, and storage of cleaning and sanitation chemicals; use of personal protective equipment (PPE); and where to find and how to read Material Safety Data Sheets (MSDS).

Explain how to complete required documentation and its importance to food safety.

Each employee should have easy access to all written SSOPs that are applicable to his or her roles and responsibilities.

Training should not be restricted to new employees. Established employees, including managers and supervisors, should also receive ongoing training
at least annually or when there are changes to the cleaning and sanitation procedures. It is important that backup personnel also receive the same training for tasks they might be required to perform on a substitute basis.

**Training Delivery**

For training to be credible to employees, it should be delivered by qualified individuals who have practical experience in cleaning and sanitation. Trainers should also be able to relate their knowledge/experience to the specific learning needs of individual trainees.

Adults learn best when the learning approach is participatory, problem-centred and relevant to their immediate circumstance. Skills and information that are immediately applicable to the job are most often remembered. Encourage active participation in training sessions by drawing on the trainee's experience. Respectfully listen and respond to trainees' questions and concerns.

Use a variety of teaching strategies to accommodate different learning preferences. For example:

• Visual—illustrations, drawings or designs; video presentations or pictures showing examples of "good" and "bad" practices; colour codes to highlight information; printed materials (e.g., copies of SSOPs, handouts, copies of presentations); wall charts; notes

• Auditory—verbal presentations such as lectures, presentations or oral reports; group discussions; verbal exchanges; real-life scenarios; one-on-one instruction

• Tactile—hands-on demonstrations; hands-on experience to learn a task; trying new things without a lengthy explanation; application exercises.

Restrict training sessions to one or two concepts per session. Several shorter sessions are much easier than one long session where employees cannot possibly absorb all the information presented. Reinforce points.

Give positive feedback whenever possible. At the next session, review topics from the most recent session, and discuss how what was learned has been put into practice and what barriers have been encountered.

Each presentation should be in a language understood by the employees. Symbols and pictures can help overcome language barriers.

The physical environment in which instruction takes place can also affect learning positively or negatively. Take into consideration the room temperature, the room arrangement, the time of day, the brightness of the room, the noise level and potential distractions.

In the workplace, reinforce what has been taught with posters, signs and other visual aids placed in strategic, high-traffic locations. Managers and supervisors should also encourage trainees to put into practice what they have learned, offer encouragement for what is done correctly and patiently correct what has been done incorrectly.

**Resources**

Good Manufacturing Practices DVD (in eight languages)
Advantage Good Manufacturing Practices Training Kit

Contact the HACCP Advantage toll-free number at 1-866-641-3663 or e-mail: HACCP.advantage@ontario.ca to receive a copy.

**Records**

All GMP training should be recorded. Records should include:

- The name of the trainee
- Trainee acknowledgment of the training by initials or signature
- The content of the training
- The date of the training
- The name of the trainer.

# ENVIRONMENTAL ASSESSMENT

## E1 Establishment Location and Construction (5—full compliance; 1—non-compliance) n/a—not applicable

| E1.1 Property and Surroundings | Rating (5 4 3 2 1 n/a) | Comments |
|---|---|---|
| 1 Grounds, roads and parking lots have adequate drainage to prevent standing water, which can provide a feeding and/or breeding area for pests, become a source of traffic-borne contamination and seep into the facility. | | |
| 2 To discourage pest breeding and harbourage, supplies and equipment are neatly stored on plant grounds at least 7 m from the buildings and at least 15 cm above the ground. Pipes within 7 m of the building are capped. | | |
| 3 Grounds, roads and parking lots are free of garbage and litter, and vegetation is cut at least 7 m from the building to minimize harbourage areas for pests. There is a 1-m wide trash-free, vegetation-free gravel or concrete strip around the perimeter of the building to discourage pest travel. | | |
| 4 Litter and waste are stored in enclosed containers. Waste is removed from the premises at appropriate intervals and in a manner that prevents spillage and litter. The dumpster area is cleaned regularly and is clear of debris and spilled waste. | | |

| E1.2 Building Exterior | Rating (5 4 3 2 1 n/a) | Comments |
|---|---|---|
| 1 Plant buildings and roofs are constructed of weather-resistant materials and are structurally sound so there is no entry of outdoor elements (rain, snow) or airborne contaminants (dust, smoke, odours). | | |
| 2 Exterior design discourages pest harbourage by eliminating ledges, nooks and crannies, etc. Cracks and crevices have been sealed to prevent entry of pests. Doors and windows are closed or screened and tight (openings less the thickness of a lead pencil). Outside drain openings are screened. | | |
| 3 Dock doors are tight and closed to discourage pest entry. Leveller plates are tight or are equipped with brush seals. There are no areas suitable for bird roosting or nesting. Dock areas are free of debris and spills. | | |

| | | |
|---|---|---|
| **E1** Possible Points | 35 | Additional Comments: |
| Actual Points | | |
| Percentage | | |

(5—full compliance; 1—non-compliance) n/a—not applicable

## E2 Establishment Design

5 4 3 2 1 n/a

| E2.1 Cross-Contamination Control | Rating | Comments |
|---|---|---|
| 1 Incompatible activities are physically separated (by walls or designated areas) or operationally separated (by scheduling or dedicated equipment) to minimize the potential for cross-contamination of ingredients, food contact surfaces, packaging materials and finished products. | | |
| 2 Traffic patterns of workers and equipment are designed and controlled to minimize travel in areas other than their designated work area. | | |
| 3 Ingredient and product flow is straight through the facility without backtracking and crossover that can cause cross-contamination. | | |
| 4 Aisles are unobstructed, and there is adequate space to permit employees to perform their duties, including cleaning and sanitation, with minimum potential for cross-contamination. | | |

5 4 3 2 1 n/a

| E2.2 Personnel Facilities | Rating | Comments |
|---|---|---|
| 1 Washrooms, change rooms and lunchrooms are constructed of durable, easily cleanable materials; are equipped with proper ventilation; have self-closing doors, adequate lighting, waste receptacles, and functioning drains; and are free of standing water. Each is separated from, and does not open directly into, sprout processing areas. | | |
| 2 Washrooms have an adequate number of sinks and toilets, hot and cold running water, "hands-free" tap controls, single-use towel dispensers, and liquid handwashing soap. Handwash signage is posted in appropriate languages. | | |
| **E2** Possible Points | 30 | **Additional Comments**: |
| Actual Points | | |
| Percentage | | |

## E3 Establishment Interior

5 4 3 2 1 n/a (5—full compliance; 1—non-compliance) n/a—not applicable

| E3.1 Internal Structures and Fittings | Rating | Comments |
|---|---|---|
| 1 Floors are constructed of smooth, non-absorbent, non-toxic, smooth material; have functioning drains; and are free of standing water. They are clean, sanitary and in good repair. | | |
| 2 Walls are constructed of non-absorbent, non-toxic, smooth, corrosion-resistant material to a height appropriate to the operation. They are in good repair. | | |
| 3 Full ceilings are easily cleanable and free of loose particles and condensation. Ladders, platforms, walkways, piping, etc. over exposed product lines are appropriately protected (e.g., kick plates on raised walkways) to prevent potential contamination. | | |

5 4 3 2 1 n/a

| E3.2 Lighting | Rating | Comments |
|---|---|---|
| 1 The intensity and quality of lighting is adequate in all areas of the facility including receiving, inspection, storage, production, and shipping, as well as in worker washrooms, change rooms and lunchrooms. | | |

5 4 3 2 1 n/a

| E3.3 Lighting Fixtures | | Comments |
|---|---|---|
| 1 All lights in receiving, shipping, production and storage areas are securely fastened to the ceiling, shielded or protected against breakage. | | |

5 4 3 2 1 n/a

| E3.4 Air Quality and Ventilation | Rating | Comments |
|---|---|---|
| 1 Ventilation adequately removes excessive heat, steam, vapours, odours, dust and condensation. Air intakes are fitted with tight-fitting screens or filters. Fans, air ducts, and other ventilation equipment are clean and well maintained. | | |

5 4 3 2 1 n/a

| E3.5 Drainage and Sewage Systems | | Comments |
|---|---|---|
| 1 The sewage and plant effluent systems are not interconnected to reduce the potential for plant contamination by sewage backup. No sewage or effluent lines pass through or over production areas unless well protected. | | |
| **E4**Possible Points | 35 | **Additional Comments:** |
| Actual Points | | |
| Percentage | | |

## E4 Equipment

**5 4 3 2 1 n/a** (5—full compliance; 1—non-compliance) n/a—not applicable

| E4.1 Equipment Design, Construction and Installation | Rating | Comments |
|---|---|---|
| 1 Equipment and utensils are designed, constructed and installed to perform an intended function and are being used to perform their intended task. There is sufficient distance between equipment (45 cm), between equipment and walls (75 cm), and equipment and floors (20 cm) to facilitate cleaning, sanitation, inspection and maintenance. Utility installations, cabinets, control panels, etc. are mounted 2.5–5 cm from walls for ease of cleaning and have sloped tops. | | |
| 2 Food contact surfaces are non-toxic, non-reactive, non-absorbent, smooth, corrosion resistant, easily cleanable, and able to withstand their processing environment and repeated cleaning. Welds are continuous and smooth. There are no overlap, stitch or spot welds. Fasteners are free of soil traps, dead spaces and metal-to-metal contact. There are no loose nuts, bolts, rivets, or washers, and no exposed threads. Support structures are round or set diagonally and capped. Equipment is free of roll-under edges, recesses, open seams, gaps, protruding edges, dead ends, and dead spaces that can trap food residues. Equipment is constructed so that all parts are easily accessible for cleaning. There are no metal-to-metal moving parts that can create physical contaminants. Belting material, belt pulleys and accessories can be easily cleaned. There is no evidence of flaking paint, rust or mould. | | |
| 3 Motors, gearboxes, drives, etc. are mounted a sufficient distance below or beside food contact surfaces (30 cm). Where they are not, adequate protection (e.g., drip pans under motors, shielding surrounding drives) is in place to prevent against contamination. Motors, gearboxes, drives, bearings, control panels, etc. are able to withstand wash/sanitizing procedures (they are water resistant or have covers/shields). Operating controls are easily accessible. | | |
| 4 Air compressor units are oil free and air lines have an adequate number of moisture traps and filters. | | |
| 5 Cooling equipment is properly sized to provide adequate time/temperature control. | | |

**5 4 3 2 1 n/a**

| E4.2 Waste Containers and Utensils | Rating | Comments |
|---|---|---|
| 1 Waste containers are clearly identified for their intended use, leak-proof, waterproof and covered. | | |
| 2 To reduce the risk of cross-contamination, utensils are identified for their intended use and kept separate from equipment and other utensils with other intended uses. | | |

| E4.3 Hand-washing Stations | | Comments |
|---|---|---|
| 1 There are an adequate number of appropriately located handwashing stations. Each has hands-free operation and is supplied with soap, warm water, and disposable paper towels or a suitable drying device. Signs in appropriate languages remind employees to wash and sanitize their hands when they become soiled or contaminated. | | |

| | | |
|---|---|---|
| **E4** Possible Points | 40 | **Additional Comments**: |
| Actual Points | | |
| Percentage | | |

## E5 Water Safety

**5 4 3 2 1 n/a** (5—full compliance; 1—non-compliance) n/a—not applicable

| E5.1 Adequate Supply and Protection of Water, Ice and Steam | Rating | Comments |
|---|---|---|
| 1 Water used in processing and cleaning activities meets potable water standards. Where required, water treatment systems are in place. | | |
| 2 Potable water lines and hoses are fitted with backflow devices to protect against potential cross-contamination. There are no hoses lying on the floor where they can impede drainage and trap water-borne contaminants. | | |
| 3 The potable water system is separate from other systems and clearly marked as such. Recycled/recirculated and/or wash water systems are clearly defined and separated from other water systems. | | |

| | | |
|---|---|---|
| **E5** Possible Points | 15 | Additional Comments: |
| Actual Points | | |
| Percentage | | |

# OPERATIONAL ASSESSMENT

(5—full compliance. 1—non-compliance) n/a—not applicable

## O1 Personnel Practices

| O1.1 Personal Hygiene/Practices | Rating<br>5 4 3 2 1 n/a | Comments |
|---|---|---|
| 1 Food handlers maintain a high degree of personal cleanliness and hygiene (e.g., clean skin and hair, no cosmetics or perfumes, no beauty aids). | | |
| 2 Food handlers do not wear jewelry or other unsecured personal objects that could fall into food. Hand jewelry that cannot be removed is securely covered with sanitary material (e.g., gloves). | | |
| 3 Food handlers refrain from using tobacco, chewing gum, eating, drinking, sneezing, coughing, spitting or other unhygienic activities. They are not observed touching their nose or mouth. | | |

| O1.2 Hand Washing | Rating<br>5 4 3 2 1 n/a | Comments |
|---|---|---|
| 1 Food handlers are observed washing their hands immediately before handling food, ingredients, packaging materials, and/or touching food contact surfaces; after using the toilet; after coughing, sneezing, blowing or wiping the nose, or touching hair or the face; after each absence from the work station for coffee breaks and eating; after handling incompatible food products, raw materials, or potentially hazardous materials such as garbage or cleaning chemicals; after picking up objects off the floor; and any other time hands become soiled or contaminated. | | |
| 2 Gloves are worn where there is direct hand contact with ingredients or product. They are maintained intact, clean and good condition. | | |
| 3 Disposable gloves are replaced when they become ripped or cut, following contamination by coughing or sneezing, after touching any non-food contact surface, after any absence from the workstation, whenever tasks change, or when potential contaminants are handled. Non-disposable rubber gloves are washed and sanitized following each of the same circumstances. | | |

5 4 3 2 1 n/a (5—full compliance; 1—non-compliance) n/a—not applicable

| O1.3 Clothing, Footwear, Headwear | Rating | Comments |
|---|---|---|
| 1 Hairnets and beard and mustache restraints are properly worn in food production, handling and other designated areas. | | |
| 2 Employee clothing and footwear are clean and sanitary and do not contribute to potential product contamination. Protective garments (aprons, smocks, etc.) are also clean and suitable to the operation, and do not contribute to potential product contamination. Objects such as pens, thermometers, tools, etc. are not carried in above-the-waist pockets where they might fall into food, equipment or containers. | | |
| 3 Protective garments are removed before entering a washroom, lunchroom, or change room, and are not worn outside the facility. When appropriate, to prevent potential cross-contamination, protective garments are changed as employees move between different processing areas. Employees adhere to designated traffic areas when moving through the facility. | | |

5 4 3 2 1 n/a

| O1.4 Storage—Clothing, Equipment, Utensils | Rating | Comments |
|---|---|---|
| 1 Employees' personal items are stored in areas separate from production, storage, and shipping and receiving areas. These storage areas are kept clean and well maintained. | | |
| 2 Specific-use equipment and utensils are clearly marked and stored in defined areas where they will not be contaminated by production or cleaning activities. | | |

5 4 3 2 1 n/a

| O1.5 Injuries and Wounds | Rating | Comments |
|---|---|---|
| 1 Employees with open sores or infected wounds are not allowed to have direct contact with food, ingredients, packaging materials or food contact surfaces. | | |

5 4 3 2 1 n/a

| O1.6 Evidence of Illness | | Comments |
|---|---|---|
| 1 High-health-risk employment candidates (those with a communicable disease and/or infections) are identified at the time of hiring. Such candidates are not suitable for work in a food handling environment. | | |
| 2 Employees with discharges from the nose, ears, and eyes, or who are coughing and sneezing are not allowed to have direct contact with food, ingredients, packaging materials or food contact surfaces. | | |

5 4 3 2 1 n/a (5—full compliance; 1—non-compliance) n/a—not applicable

| O1.7 Access and Traffic Patterns | Rating | Comments |
|---|---|---|
| 1 Measures are in place to restrict access to the facility to authorized personnel only (e.g., physically or electronically monitored). Specific areas of access are clearly defined for personnel who are not escorted (e.g., truck drivers, outside contractors). All other facility visitors are escorted by plant personnel at all times. | | |
| 2 Within the facility, easily identifiable food handlers and others are restricted to specific traffic and work areas. No personnel are found in unauthorized areas. | | |

5 4 3 2 1 n/a

| O1.8 Chemical Use | Rating | Comments |
|---|---|---|
| 1 All chemicals used for cleaning, sanitizing and processing are listed in the CFIA's *Reference Listing of Accepted Construction, Packaging Materials and Non-Food Chemical Products.* | | |
| 2 All chemical containers are correctly labelled and stored in secure, locked areas where they do not pose a contamination risk to food, ingredients, packaging materials or food contact surfaces. Incompatible chemicals are stored in separate areas. | | |
| 3 Material Safety Data Sheets (MSDS) are on file for all chemicals used in the facility. The sheets are easily accessible to all those who use any of these chemicals. | | |

5 4 3 2 1 n/a

| O1.9 Chemicals Used During Operations | Rating | Comments |
|---|---|---|
| 1 Chemicals are appropriate for their intended use and are used at correct concentrations. Care is taken during chemical use to ensure they don't contaminate adjoining production, packaging, storage and shipping areas. Chemical containers not in use are not present in processing, packaging, storage and shipping areas. | | |

| | | |
|---|---|---|
| **O1** Possible Points | 100 | **Additional Comments:** |
| Actual Points | | |
| Percentage | | |

## O2 Shipping, Receiving, Handling and Storage

**5 4 3 2 1 n/a** (5—full compliance; 1—non-compliance) n/a—not applicable

| O2.1 Conveyance Vehicles | Rating | Comments |
|---|---|---|
| 1 Incoming and outgoing conveyance vehicles are constructed of durable, easily cleanable materials, and are clean, odour free, well maintained, contamination free and appropriate for their cargo. They are capable of maintaining proper product temperatures and preventing product contamination. | | |

**5 4 3 2 1 n/a**

| O2.2 Loading and Unloading Practices | Rating | Comments |
|---|---|---|
| 1 During loading and unloading, reasonable care is exercised to minimize damage to product, containers and the vehicle itself. To avoid potential cross-contamination, only clean, sound loading/unloading equipment and containers are used. | | |
| 2 Loads are assembled in such a way that they will retain their integrity during transit. | | |

**5 4 3 2 1 n/a**

| O2.3 Received Products | Rating | Comments |
|---|---|---|
| 1 Incoming food, ingredients, food/ingredient containers, packaging materials, and all other materials meet written predetermined specifications/standards for food safety and quality. Anything that does not meet these standards is rejected. | | |
| 2 Incoming materials are clearly identified. A vendor's lot code is present to permit traceability through the production system and back to the supplier. To facilitate First In, First Out (FIFO) inventory rotation, the date of manufacture, best-before date or date of receipt is indicated. | | |

**5 4 3 2 1 n/a**

| O2.4 Shipping Conditions | Rating | Comments |
|---|---|---|
| 1 First In, First Out (FIFO) is practised. Products are staged in enclosed, temperature-controlled areas as close to shipping as possible. Perishable product vehicles are precooled before loading. | | |
| 2 The shipping/receiving area is kept organized, tidy, clean, and free of debris and spoiled product to prevent cross-contamination. Spills are cleaned up immediately. | | |

**5 4 3 2 1 n/a**

| O2.5 Returned and Defective Food Products | Rating | Comments |
|---|---|---|
| 1 Returned food products are clearly identified and segregated in controlled areas until disposition (disposal) has been determined. | | |
| 2 Rejected ingredients/products not immediately returned to the supplier are clearly marked and segregated in controlled areas until their return to the supplier. | | |

5 4 3 2 1 n/a (5—full compliance; 1—non-compliance) n/a—not applicable

| O2.6 Allergen Control | Rating | Comments |
|---|---|---|
| 1 Ingredient suppliers are required to provide a complete list of ingredients including allergens. The presence of allergens is noted in all formulation and production records. | | |
| 2 Allergen-containing ingredients and products are properly labelled. They are stored in designated, controlled areas and have their own dedicated dispensing utensil and weigh container. | | |
| 3 Production scheduling and cleaning/sanitation procedures minimize the potential for allergen cross-contamination. Procedures for control of allergens are documented. | | |

5 4 3 2 1 n/a

| O2.7 Packaging | Rating | Comments |
|---|---|---|
| 1 Only new, food-grade, single-use packaging is used for microbially sensitive products. Reusable containers (e.g., bins, boxes, totes) are cleaned/sanitized between uses or have protective liners. | | |
| 2 Stored and staged packaging materials are kept clean, dry and free from contamination. | | |
| 3 When glass materials are used in processing and storage areas, a written glass control program is in place to prevent contamination in the event of glass breakage. | | |

5 4 3 2 1 n/a

| O2.8 Storage Practices | Rating | Comments |
|---|---|---|
| 1 All stored ingredients, materials and packaging are stored under appropriate temperature and humidity conditions. Materials are stored in a orderly manner in a way that permits adequate air flow and maintains the integrity of the product, ingredients or packaging. Products are not stored in the shipping and receiving areas. | | |
| 2 All storage areas are clean and free of debris and litter. Spills are cleaned up promptly. Stored ingredients, materials and packaging are clean, dry, intact and properly packaged to prevent contamination. | | |
| 3 Sufficient space is maintained along all walls, and materials are stored at an adequate height above the floor to permit proper cleaning and monitoring for pest activity. | | |
| 4 Temperatures of refrigerated products are monitored regularly and documented. Ingredients and finished products that require refrigeration are cooled rapidly and without delay to prevent microbial growth. | | |
| 5 Documented First In, First Out (FIFO) rotation practices are used for storage of raw materials, finished products and packaging. Each is clearly labelled and dated to assist in FIFO implementation | | |
| 6 Storage areas are separated from areas of other activity. | | |

5 4 3 2 1 n/a (5—full compliance: 1—non-compliance) n/a—not applicable

| O2.9 Chemical Storage | Rating | Comments |
|---|---|---|
| 1 When not in use, chemicals are stored in separate, access-controlled areas, separate from food, ingredients, packaging supplies and food contact surfaces. | | |

5 4 3 2 1 n/a

| O2.10 Waste Management | Rating | Comments |
|---|---|---|
| 1 Interior solid waste containers are clearly identified, covered and not leaking. None are overflowing. Emptying is handled in a way that does not have the potential to contaminate goods, ingredients or packaging. Containers are cleaned after emptying so as not to be a source of contamination or act as an attractant to pests. | | |
| 2 Inedible waste containers are located close to the waste source but not in the way of processing activities. Waste is not decaying. Containers are not overflowing. Emptying is handled in a way that does not have the potential to contaminate goods, ingredients or packaging. Containers are cleaned after emptying so as not to be a source of contamination or act as an attractant to pests. | | |
| 3 Exterior waste containers are clearly identified, covered and do not leak. None are overflowing. The waste is not aged. All are located far enough away from the facility to discourage rodent travel. | | |
| 4 Wastewater is handled in a manner that will not create the potential for cross-contamination or attract pests. | | |

| | | |
|---|---|---|
| **O2** Possible Points | 130 | **Additional Comments:** |
| Actual Points | | |
| Percentage | | |

## O3 Sanitation

5 4 3 2 1 n/a (5—full compliance; 1—non-compliance) n/a—not applicable

| O3.1 Cleaning and Sanitation | Rating | Comments |
|---|---|---|
| 1 Sanitation Standard Operating Procedures (SSOPs) are in place to identify areas, equipment and utensils to be cleaned, the frequency of cleaning, the procedures and chemicals to be used, those responsible, the procedure to verify effectiveness and the records required. | | |
| 2 No cleaning practices are observed during operations that could potentially cause product contamination. For example, food and packaging are protected from contamination during cleanups. Water and air pressure is used in a way that does not create water droplets or aerosols that could potentially contaminate food, packaging or food contact surfaces. | | |
| 3 Cleanliness is evident throughout the facility in both production and non-production areas. Food contact surfaces are clean. There are no buildups or accumulations of food products or soil. Spills are cleaned up promptly. Utensils used during processing are cleaned and sanitized regularly. Floors are free of standing water. Hoses are neatly stored off the floor. Good housekeeping practices are observed. | | |
| 4 Cleaning/sanitizing containers, brushes, applicators, etc. are labelled or colour-coded to prevent inadvertent use in unintended areas where there is potential for cross-contamination. | | |
| 5 There is evidence that materials/systems for checking sanitizer concentration levels are in place and used at appropriate intervals. | | |

5 4 3 2 1 n/a

| O3.2 Pre-operational Assessment | Rating | Comments |
|---|---|---|
| 1 A designated individual(s) other than the individual(s) who performed the cleaning/sanitizing operations routinely performs a sanitation assessment before operations begin or resume. Operations do not start until sanitation standards meet SSOP requirements. | | |

| | | |
|---|---|---|
| **O3** Possible Points | 30 | **Additional Comments**: |
| Actual Points | | |
| Percentage | | |

## O4 Equipment Maintenance

**5 4 3 2 1 n/a** (5—full compliance; 1—non-compliance) n/a—not applicable

| O4 Preventive Maintenance and Calibration Monitoring | Rating | Comments |
|---|---|---|
| 1 There is a preventive maintenance program in place for inspection, testing, lubrication, cleaning, adjusting, and parts replacement based on manufacturer's recommendations and operating conditions. | | |
| 2 During maintenance and repair activities, steps are taken to reduce the risk of contamination of food, ingredients, packaging and food contact surfaces. This may include removing food from the area or covering it; monitoring time delays and temperature fluctuations that may contribute to contamination or decomposition; using tools dedicated to specific tasks; tool and parts reconciliation at the conclusion of the maintenance activity; wiping away excess lubricant; and cleaning/sanitizing before resumption of processing activities. Maintenance/repair workers, including temporaries and contractors, follow all personnel hygiene policies. | | |
| 3 All repair/maintenance materials (including those used for temporary repairs) and lubricants are included in the CFIA's *Reference Listing of Accepted Construction Materials, Packaging Materials and Non-Food Chemical Products.* | | |
| 4 Measuring and monitoring devices are routinely calibrated according to manufacturers' instructions and frequencies. Records of calibration activities are maintained. | | |

| | | |
|---|---|---|
| **O4** Possible Points | 20 | **Additional Comments:** |
| Actual Points | | |
| Percentage | | |

## O5 Pest Control

**5 4 3 2 1 n/a** (5—full compliance; 1—non-compliance) n/a—not applicable

| **O5.1 Pest Control Monitoring** | **Rating** | **Comments** |
|---|---|---|
| 1 There is no interior evidence of pest nesting activity, decomposed pests in the pest control devices, burrowing, excreta droppings, urine stains, footprints or gnawing. There are an adequate number of tamper-resistant pest control devices spaced at consistent intervals around the interior walls of the facility including on both sides of exterior doors. Toxic bait is not used inside the facility. There is proof that the pest control devices are monitored daily where there is evidence of pest activity or biweekly if no activity is evident. | | |
| 2 There are an adequate number of tamper-resistant pest control stations spaced at appropriate intervals around the building's exterior perimeter. Stations are secured in place and bait is anchored inside. They are situated so they do not contaminate product, packaging or equipment. Bait is adequate and fresh. There is proof that the pest control devices are monitored daily where there is evidence of rodent activity or biweekly if no activity is evident. | | |
| 3 There is no evidence of insects, flies or birds inside the facility. There is no evidence of insect, fly, bird or rodent contamination on or in any food products. | | |
| 4 There are an adequate number of insect control devices. They are positioned to maximize their efficiency but at an adequate distance from exposed food, ingredients and food contact surfaces. There is proof that they are monitored and serviced on an appropriate schedule. | | |
| 5 All pest control devices are of sound construction, in good repair and functioning properly. | | |
| 6 All pesticides meet CFIA regulations. They are properly labelled and kept in locked, secured areas away from any food or processing areas. | | |

| | | |
|---|---|---|
| **O5**Possible Points | 30 | **Additional Comments**: |
| Actual Points | | |
| Percentage | | |

## O6 Recall

**5 4 3 2 1 n/a** (5—full compliance; 1—non-compliance) n/a—not applicable

| O6.1 Product Code/Label Monitoring | Rating | Comments |
|---|---|---|
| 1 All raw materials and finished products are identified with a permanent, legible code or lot number to enable traceability. Finished products can be traced back through the production process to raw materials, and raw ingredients can be traced forward to the finished product. | | |
| 2 Product code information, distribution records, and customer and facility contact names are current and readily available. A mock recall is conducted at least once a year. | | |
| 3 Product labels are correct, not misleading or deceptive, and accurately describe ingredients, including allergens if they are present. A label reconciliation program is in place. It includes regular review of product labels versus product being packaged, inspection of labels at receipt to ensure accuracy, and removal and destruction of obsolete labels. | | |

**5 4 3 2 1 n/a**

| O6.2 Mock Recalls | Rating | Comments |
|---|---|---|
| 1. A mock recall is conducted at least once a year. | | |

| | | |
|---|---|---|
| **O6** Possible Points | 20 | **Additional Comments:** |
| Actual Points | | |
| Percentage | | |

## O7 Water Safety

**5 4 3 2 1 n/a** (5—full compliance; 1—non-compliance) n/a—not applicable

| O7.1 Water Treatment Monitoring | Rating | Comments |
|---|---|---|
| 1 Water used for processing (washing, rinsing or conveying food) does not increase the level of contamination of the food. To ensure that water is potable, municipal water is laboratory tested at least twice a year. Water from other sources is tested at least once per month. Recycled water is routinely analyzed at a frequency appropriate to its degree of potential contamination. Water test records are retained. | | |
| 2 Water contact surfaces (e.g., dump tanks, wash tanks, flumes, hydro coolers) are cleaned/sanitized regularly enough to prevent ingredient/product contamination. | | |
| 3 The level of disinfection of treated water used for washing, rinsing or conveying food is tested frequently to ensure that disinfectant levels remain effective but are not at levels that could contaminate food, ingredients, packaging or equipment. | | |
| 4 Water treatment and filtering equipment is appropriate for its application and well maintained. Metering devices are monitored and filters replaced before they become ineffective. | | |
| 5 A contingency plan is in place to deal with unsatisfactory water. | | |

| O7.2 Water Safety Monitoring | | |
|---|---|---|
| 1 Water safety monitoring and testing procedures are described in detail. Activities are overseen to ensure proper completion and any necessary follow-up activities. | | |

| | | |
|---|---|---|
| **O7** Possible Points | 30 | **Additional Comments**: |
| Actual Points | | |
| Percentage | | |

## CONTROL PROGRAM ASSESSMENT

**5 4 3 2 1 n/a** (5—full compliance; 1—non-compliance) n/a—not applicable

| **P1 Personnel Practices** | **Rating** | **Comments** |
|---|---|---|
| 1 There is a written program in place describing food handler personal hygiene policy, procedure and controls. | | |
| 2 There is a written program in place describing food handler handwashing policy, procedure and controls. | | |
| 3 There is a written program in place describing food handler clothing, footwear, and headwear policy, procedure and controls. | | |
| 4 There is a written program in place describing food handler clothing, equipment, and utensils storage policy, procedure and controls. | | |
| 5 There is a written program in place describing food handler injury and wound policy, procedure and controls | | |
| 6 There is a written program in place describing food handler illness policy, procedure and controls. | | |
| 7 There is a written program in place describing facility access and food handler and equipment traffic patterns that will minimize the potential for contamination of food, ingredients and packaging materials. | | |
| 8 There is a written program in place describing chemical use and handling policy, procedure and controls. A master list of chemicals and relevant Material Safety Data Sheets are readily available. | | |
| 9 There is a written program in place describing chemical use policy, procedure and controls during operations. | | |
| 10 There is a written training program for each of the components listed above. The written programs may be used as a training aid. | | |

| | | |
|---|---|---|
| **P1** Possible Points | 50 | **Additional Comments:** |
| Actual Points | | |
| Percentage | | |

**5 4 3 2 1 n/a** 5—full compliance; 1—non-compliance) n/a—not applicable

| **P2 Shipping, Receiving, Handling and Storage** | **Rating** | **Comments** |
|---|---|---|
| 1 There is a written program in place describing conveyance vehicle policy, procedure and controls. | | |
| 2 There is a written program in place describing loading and unloading policy, procedure and controls. | | |
| 3 There is a written program in place describing received product policy, procedure and controls. | | |
| 4 There is a written program in place describing shipping conditions policy, procedure and controls. | | |
| 5 There is a written program in place describing returned and defective food products policy, procedure and controls | | |
| 6 There is a written program in place describing allergen policy, procedure and controls. | | |
| 7 There is a written program in place describing packaging policy, procedure and controls. | | |
| 8 There is a written program in place describing food, ingredient, and packaging storage policy, procedure and controls. | | |
| 9 There is a written program in place describing chemical storage policy, procedure and controls. | | |
| 10 There is a written program in place describing waste management policy, procedure and controls. | | |
| 11 There is a written training program for each of the components listed above. The written programs may be used as a training aid. | | |

| | | |
|---|---|---|
| **P2** Possible Points | 55 | **Additional Comments:** |
| Actual Points | | |
| Percentage | | |

**5 4 3 2 1 n/a** (5—full compliance; 1—non-compliance) n/a—not applicable

| **P3 Sanitation** | **Rating** | **Comments** |
|---|---|---|
| 1 There is a written sanitation program in place. The sanitation program includes the building areas, equipment, and utensils to be cleaned and sanitized; the frequency of cleaning and sanitation for each building area, each piece of equipment, and each utensil; the procedures for cleaning and sanitizing; the chemicals to be used, their concentrations and the temperature of the cleaning or sanitizing solution; the job position responsible for each cleaning and/or sanitizing task; a procedure to verify that the cleaning and sanitizing has been effective; and the record keeping required. | | |
| 2 There is a written program in place describing preoperational assessment policy, procedure and controls. | | |
| 3 There is a written sanitation training program. The written program may be used as a training aid. | | |

| | | |
|---|---|---|
| **P3** Possible Points | 15 | **Additional Comments**: |
| Actual Points | | |
| Percentage | | |

| **P4 Equipment Maintenance** | | |
|---|---|---|
| 1 There is a written program in place describing preventive maintenance and calibration monitoring policy, procedure and controls. The program includes personnel responsible; a description of the maintenance and/or calibration activity; the frequency of the maintenance/calibration activity; procedures to minimize the potential for cross-contamination, and the records to be completed. | | |
| 2 There is a written maintenance/calibration training program. The written programs may be used as a training aid. | | |

| | | |
|---|---|---|
| **P4** Possible Points | 10 | **Additional Comments**: |
| Actual Points | | |
| Percentage | | |

5 4 3 2 1 n/a (5—full compliance; 1—non-compliance) n/a—not applicable

| P5 Pest Control | Rating | Comments |
|---|---|---|
| 1 There is a written program in place describing pest control policy, procedure and controls. The program should designate a pest control operator (either existing staff or an outside pest control company); outline the responsibilities and activities of the pest control operator (PCO); schedule pest control activities; specify the pesticides and mechanical devices to be used; include a map indicating the location and type of each internal and external pest control device (e.g., glue boards, insect light traps, tin cats, mechanical traps, etc.) each numbered for ease of tracking; and outline the documentation required to record the chemicals used, where these chemicals were used, any signs of pest activity, the corrective action taken in the event of pest activity, and the signature of the pest control operator as verification of his or her activity. | | |
| 2 If company staff carry out pest control activities they should be properly trained. The written programs may be used as a training aid. | | |
| | | |

| | | |
|---|---|---|
| **P5** Possible Points | 10 | **Additional Comments:** |
| Actual Points | | |
| Percentage | | |

5 4 3 2 1 n/a

| O6 Recall | Rating | Comments |
|---|---|---|
| 1 There is a written program in place describing recall policy, procedure and controls. The program should include the person(s) responsible for coordinating and implementing a recall; procedures to identify, locate and control the implicated product; measures to investigate violation causes and steps to control them; and procedures to test effectiveness of the recall at predetermined intervals. | | |
| 2 There is a written recall training program. The written programs may be used as a training aid. | | |

| | | |
|---|---|---|
| **P6** Possible Points | 10 | **Additional Comments:** |
| Actual Points | | |
| Percentage | | |

5 4 3 2 1 n/a (5—full compliance; 1—non-compliance) n/a—not applicable

| O7 Water Safety | Rating | Comments |
|---|---|---|
| 1 There is a written program in place describing water treatment policy, procedure and controls. The program should include the water treatment activity to be performed (e.g., UV treatment of well water, wash water chlorination, filtering/treatment of recycled wash water or flume water); the personnel responsible for each of the treatment activities; the chemicals/equipment required for each treatment; explicit directions as to how to use the required equipment, including filter, screen, etc. cleaning and maintenance. For chemicals, explicit directions as to proper handling of the chemicals (for personal safety and to prevent or minimize contamination), including the concentration to be used; the criteria/schedule for water treatment activities; and the documentation required. | | |
| 2 There is a written program in place describing water monitoring policy, procedure and controls. The program should include a list of the water samples to be collected and the schedule for collecting them; a detailed description of the water sample collection and sample submission procedures; the personnel responsible for each task; documentation requirements for each sample; and the actions to be taken when the water analysis does not meet predetermined criteria. | | |
| 3 There is a written water treatment/monitoring training program. The written programs may be used as a training aid. | | |
| **P7** Possible Points | 15 | **Additional Comments:** |
| Actual Points | | |
| Percentage | | |

## SUMMARY

| Control Program Element | Percentage | Comments |
|---|---|---|
| 1 Personnel Practices | | |
| 2 Shipping, Receiving, Handling and Storage | | |
| 3 Sanitation | | |
| 4 Equipment Maintenance | | |
| 5 Pest Control | | |
| 6 Recall | | |
| 7 Water Safety | | |

## GLOSSARY

**acid**—a substance containing a high concentration of hydrogen ions, which creates a pH value less than 7.0

**activated carbon**—charcoal that has been burned in the absence of oxygen to increase the adsorptive surface area of the carbon

**adsorption**—adhesion of a substance to the *surface* of a solid or liquid

**aerosols**—suspended droplets of liquid containing microorganisms; often caused by splashing water against contaminated surfaces in a sprout processing environment

**alkaline**—a substance with a relatively low concentration of hydrogen ions, which creates a pH value greater than 7.0

**ATP bioluminescence**—adenosine triphosphate (ATP) is an energy molecule found in all organic substances. When luciferin/luciferase enzyme (found in fireflies) reacts with ATP, light is released. Measuring light intensity (ATP bioluminescence) with a luminometer provides an indication of the level of biological residue on a surface

**bacteria**—microscopic, single-celled organisms found in soil, air, water, and the intestinal tract and mucous membranes of animals and humans; these cells multiply by dividing in two (binary fission)

**biofilm**—an invisible layer of organic secretions, attached to surfaces that appear to be clean and sanitary, that harbours living bacteria cells; can be difficult to remove during cleaning and sanitation procedures

**Canadian Food Inspection Agency (CIFA)**—the federal agency responsible for the enforcement of the policies and standards under the Agriculture and Agri-Food Administrative Monetary Penalties Act, Canada Agricultural Products Act, Canadian Food Inspection Agency Act, Feeds Act, Fertilizers Act, Fish Inspection Act, Health of Animals Act, Meat Inspection Act, Plant Breeders' Rights Act, Plant Protection Act, Seeds Act, and the Consumer Packaging and Labelling Act, and the enforcement of the Food and Drugs Act as they relate to food; focuses on federally registered establishments that engage in interprovincial and export trade

**Canadian General Standards Board (CGSB)**—an agency of the Government of Canada, it offers independent certification services. It is the auditing body for the *GMP Advantage*, *HACCP Advantage* and *HACCP Advantage Plus+* programs

**Canadian Horticultural Council (CHC)**—a voluntary, not-for-profit, national association representing producers and packers of over 120 horticulture crops including fruit, vegetables, flowers and ornamental plants

**Center for Science in the Public Interest (CSPI)**—a U.S. consumer advocacy group that focuses on food and nutrition issues

**chelating agent**—an organic compound that keeps metals in water from combining; also known as sequestering agents, chelating agents prevent metal buildup that causes staining

**chemical agent**—a compound that increases the effectiveness of water in removing soil and other foreign materials from surfaces

**cleaning**—the process of removing surface dirt, debris and associated bacteria from a surface by washing with water and detergent

**clean-in-place (CIP)**—a continuous system whereby cleaning or sanitizing agents are recirculated through intact machinery

**clean-out-of-place (COP)**—a cleaning and sanitizing system used for equipment that can be disassembled and placed in a soak or circulating tank

**Codex Alimentarius Commission**—an international organization created in 1963 by the Food and Agriculture Organization and the World Health Organization to protect the health of consumers, ensure fair food trade practices, and promote co-ordination of all food standards work undertaken by international governmental and non-governmental organizations

**condensate**—water that has been produced by the cooling of steam or water vapour

**contamination**—the transfer of harmful substances or disease-causing microorganisms to sprouts by hands, food contact surfaces, and utensils that touch contaminated seeds and sprouts

**critical control points (CCPs)**—a point, step or procedure in a food manufacturing process at which a control measure can be applied to eliminate, prevent or reduce a food safety hazard to an acceptable level

**cross-contamination**—the physical movement, or transfer, of harmful microorganisms or trace allergen products from one person, object, food or place to another

**effluent**—liquid or waterborne waste of industrial or commercial origin that has been treated

**enteric pathogens**—illness or disease-causing microorganisms found in the intestinal tract of humans

**fat-oil-grease buildup (FOG)**—the accumulation of grease in sumps, drains and traps

**Food and Agriculture Organization (FAO)**—an agency of the United Nations serving both developed and developing countries, it helps developing countries and countries in transition modernize and improve agriculture, forestry, and fisheries practices and ensure good nutrition for all

**food contact surface**—any equipment or utensil that normally comes in contact with the food product or surfaces normally in contact with the product

**Food Safety Enhancement Program (FSEP)**—the Canadian Food Inspection Agency's (CFIA's) program to encourage and support the development, implementation and maintenance of Hazard Analysis Critical Control Point (HACCP) systems in all federally registered establishments of the meat, dairy, honey, maple syrup, processed fruit and vegetable, shell egg, processed egg and poultry hatchery sectors

**food spoilage microorganisms**—fungi and bacteria that impair the flavour, aroma and appearance of a food; they include *Pseudomonas* spp., lactic acid bacteria such as *Leuconostoc mesenteroides* and *Lactobacillus* spp., *Erwinia herbicola, Flavobacterium, Xanthomonas, Enterobacter agglomerans*, yeasts and moulds; the type and magnitude of microbial growth can vary greatly for different produce items and storage conditions

**fungi**—parasitic organisms that lack chlorophyll, they grow on living or dead organisms; yeast, moulds, rusts, mildews, smuts and mushrooms are types of fungi

**Good Agricultural Practices (GAPs)**—systematic approaches to prevent or control contamination of crops during growing, harvesting and transporting. Key areas of concern include prior land use; adjacent land use; water quality and use practices; soil fertility management; wildlife, pest and vermin control; worker hygiene and sanitary facilities; and harvesting and cooling practices

**Good Manufacturing Practices (GMPs)**—the basic, universal conditions that control hazards related to personnel and the food manufacturing environment; GMPs create conditions favourable for the production of safe food

**Granular Activated Carbon (GAC)**—a relatively loose bed of activated carbon granules used for liquid or gas filtration. Because the carbon grains are loosely held, open paths may be created, shortening contact time and making filtration less effective

**HACCP (Hazard Analysis Critical Control Points)**—an internationally recognized, science-based, food safety program designed to reduce, prevent, or eliminate potential biological, chemical, and food safety hazards directly related to the food being processed or the manufacturing process

**heterotrophic**—organisms capable of deriving energy for life processes only from the decomposition of organic compounds, and incapable of using inorganic compounds as sole sources of energy or for organic synthesis

**heterotrophic plate count (HPC)**—procedure for estimating the total number of live heterotrophic bacteria in a sample. Used as an indicator of poor general biological quality, this test detects a broad group of bacteria including non-pathogens, pathogens and opportunistic pathogens, but it does not assume to report all of the bacteria in the sample.

**inorganic**—derived from mineral sources; examples include sand, salt, iron and calcium salts

**luminometer**—a sensitive photometer used for measuring very low light levels

**Material Safety Data Sheets (MSDS)**—fact sheets designed to reflect the hazards of working with and/or storing a particular chemical, they provide workers with information such as physical data, toxicity, health effects, first aid, reactivity, storage, disposal, protective equipment and spill/leak procedures

**microbe**—another word for a microorganism

**microorganisms**—living entities that are too small to be visible to the naked eye; they include bacteria, viruses, protozoa, and fungi such as yeasts and moulds. When used as an adjective, the term is "microbial"

**microbial**—an adjective used to express an attribute relating to microorganisms e.g., the microbial quality of water

**modified atmosphere packaging (MAP)**—packaging that allows the exchange of gases and moisture to produce the optimal storage environment to slow product deterioration and maximize protection from food safety contaminants

**moulds**—multicellular organisms that form fuzzy or powdery patches (mycelium) on organic matter such as fruits and vegetables; moulds are fungi

**non-potable water**—water that is unsafe to drink because it contains pollutants, contaminants, minerals or disease-causing microorganisms

**organic**—carbon-containing compounds obtained from plant or animal sources

**parasites**—organisms that obtain nourishment from a living plant or animal in order to grow and reproduce, usually to the detriment of the host

**pathogen**—a microorganism that is capable of causing illness or disease when it enters the human body

**pathogenic microorganisms**—illness- or disease-causing bacteria, protozoa, viruses or fungi

**personal protective equipment (PPE)**—equipment or clothing worn to prevent injury or illness from occurring while handling hazardous materials

**pest control operator (PCO)**—person or company licensed to apply pesticides

**pH**—the acidity or alkalinity of a liquid measured by the concentration of free hydrogen ions and expressed on a logarithmic scale. If the pH is below 7.0, the solution is acidic (the lower the number, the greater the degree of acidity); if it is above 7.0, the solution is alkaline (the higher the number, the greater the level of alkalinity). A pH of 7.0 is neutral (neither acid nor alkaline).

**phytochemicals**—chemical compound (such as beta-carotene) occurring naturally in plants

**phytosanitary**—inspection pertains to activities (e.g., sanitary plant health inspection) designed to prevent the introduction and/or spread of quarantine pests or to ensure their official control

**potable water**—water that is safe for drinking. Potable water meets the requirements of the *Guidelines for Canadian Drinking Water Quality* published by Health Canada as well as any applicable provincial requirements

**prepackaged product**—as per the Food and Drugs Act, any food that is contained in a package in the manner in which it is ordinarily sold to, or used or purchased by a person.

**processing aids**—substances/ingredients that are added to a food for a technological effect during processing and which are not present in the finished food product or are

present at insignificant and non-functional levels (e.g., wood chips, synthetic casings, cleaners, sanitizers, washing and peeling agents, headspace flushing gases)

**refrigeration**—exposure to a temperature of 4°C or less but not frozen (as per Food and Drug Regulations, B.27.001)

**reverse osmosis (RO)**—a process in which water is forced under pressure through a synthetic semi-permeable membrane to remove unwanted substances

**Sanitation Standard Operating Procedure (SSOP)**—written step-by-step procedures that describe in detail how cleaning and sanitation procedures should be done to comply with GMP requirements related to cleaning and sanitation

**sanitizing**—use of heat or chemicals to reduce the number of microorganisms on a clean surface to safe levels

**sewage**—waste of domestic origin (human body waste, and waste from showers, tubs, sinks and laundry)

**Solid Block Activated Carbon (SBAC)**—created by compressing very fine activated charcoal with a binding medium and fusing them into a solid block. The intricate maze created ensures complete contact with impurities and their effective removal from water filtered through the SBAC.

**Standard Operating Procedures (SOPs)**—written step-by-step procedures that describe in detail how a procedure should be done to comply with GMP requirements, except those related to cleaning and sanitation

**surfactant**—an agent that reduces the surface tension of a liquid (usually water) to permit the penetration of cleaning compounds by increasing the emulsifying, foaming, dispersing, spreading and wetting properties of a product; reduces the surface tension between two liquids

**Total Plate Count (TPC)**—another term for Heterotrophic Plate Count (HPC) test

**trihalomethanes (THMs)**—A group of low-molecular-weight, halogenated hydrocarbons, derivatives of methane ($CH_4$), in which three halogen atoms (chlorine, bromine or iodine) are substituted for three of the hydrogen atoms. The group includes suspect human carcinogens. Small amounts of THMs have been detected in raw water collected from surface sources used as a public water supply, and concentrations have been shown to be increased during the chlorination phase of the water purification process

**turbidity**—cloudiness in water caused by suspension of clay, silt, other finely divided organic and inorganic matter, and microscopic organisms

**seed lot**—a quantity of seeds produced and handled under uniform conditions with as little variation as possible (e.g., seeds grown under similar agricultural practice, on the same land and harvested during the same period)

**sprout lot**—a quantity of sprouts produced and handled under uniform conditions with as little variation as possible and harvested on the same day (e.g., sprouts produced from a single seed lot, germinated, grown and harvested at the same time using the same disinfection and growing methods and type of equipment)

**sprouted seed**—any seed that has been sprouted for human consumption, including seeds grown in soil

**U.S. Centers for Disease Control and Prevention (CDC)**—as one of the 13 major operating components of the U.S. Department of Health and Human Services (HHS), it conducts research and investigations to prevent and control infectious and chronic diseases, injuries, workplace hazards, disabilities and environmental health threats

**United States Food and Drug Administration (USFDA)**—federal regulatory agency for food, drugs, medical devices, biologics, animal feed and drugs, cosmetics and radiation-emitting products in the United States

**virus**—an ultramicroscopic piece of nucleic acid (DNA or RNA) wrapped in a thin coat of protein that can be seen only with an electron microscope; very infectious and often pathogenic, a virus reproduces by inserting itself into a living host cell and altering the function of that cell

**wastewater**—water that has been adversely affected in quality by human, industrial, agricultural or commercial processes

**Workplace Hazardous Materials Information System (WHMIS)**—a comprehensive national system for safe management of hazardous chemicals that is legislated by both the federal and provincial governments. Under WHMIS legislation, all suppliers (manufacturers, importers, packagers and processors) are required to label and prepare Material Safety Data Sheets (MSDSs) for products they make, import, package or process that meet the hazard criteria set out in the Controlled Product Regulations under the federal Hazardous Products Act.

**World Health Organization (WHO)**—specialized agency of the United Nations that acts as a co-ordinating authority on international public health; 192 countries are members

**yeast**—a unicellular fungus that grows spherical or oval single cells rather than mycelium; can be either beneficial or detrimental in sprout processing

## OMAFRA Contacts

OMAFRA has a specialist on staff to assist sprout growers with sprout safety issues. Please do not hesitate to contact him.

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- Paul Bailey, Ontario Ministry of Agriculture, Food and Rural Affairs
- Luis Garcia, Ontario Ministry of Agriculture, Food and Rural Affairs
- Dr. William Fett, Agricultural Research Service, United States Department of Agriculture, Wyndmoor, Pennsylvania
- Earl Hauserman, Brassica Protection Products LLC
- Nadean Kennedy, Ontario Ministry of Agriculture, Food and Rural Affairs
- John Lee, Toronto Sun Wah Trading Inc., Toronto, Ontario
- Kenneth Lee, Good Taste Foods, Scarborough, Ontario
- Irene Mentis, Canadian Food Inspection Agency, Scarborough, Ontario
- Jim Mumm, Mumm's Seeds, Parkside, Saskatchewan
- Terry Peters, Canadian Food Inspection Agency, Burnaby, British Columbia
- Bob Rust, International Specialty Supply, Cookeville, Tennessee
- Bob Sanderson, Jonathan's Sprouts, Rochester, Massachusetts
- Dr. Don Schaffner, Rutgers University, New Brunswick, New Jersey
- Dr. Trevor Suslow, University of California, Davis, California
- Jessie Taras, AquaFushia, Montreal, Quebec
- Dr. Keith Warriner, University of Guelph, Guelph, Ontario